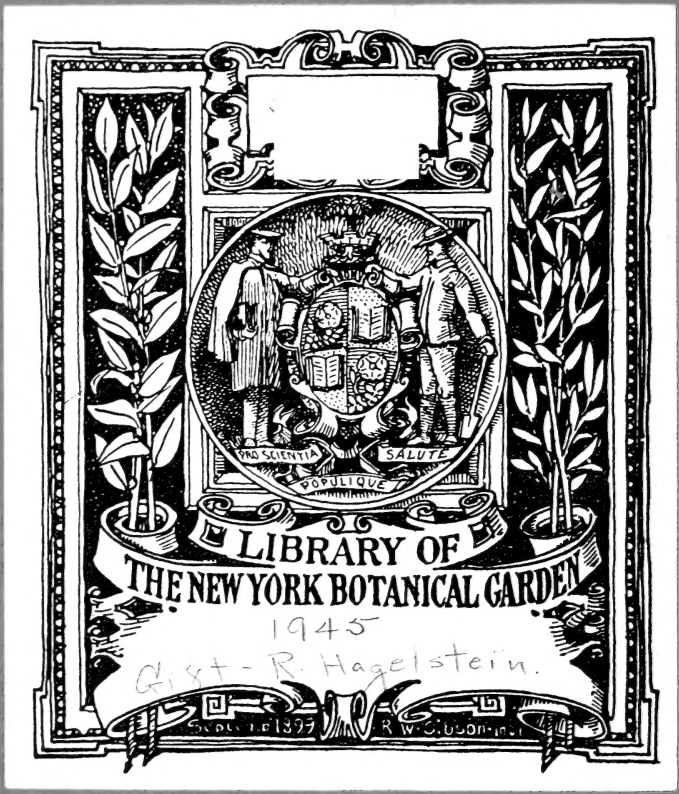
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THE MICROSCOPE.

AN ILLUSTRATED MONTHLY DESIGNED TO POPULARIZE THE SUBJECT OF MICROSCOPY.

Edited by

CHAS. W. SMILEY, A. M.

VOL. III, NEW SERIES. (NOS. 25-36.)

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THE MICROSCOPE.

JANUARY, 1895.

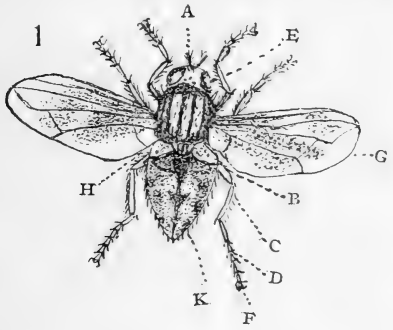
NUMBER 25. NEW SERIES.

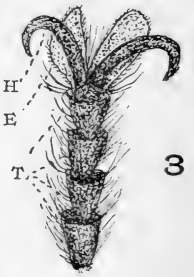
Objects Seen Under the Microscope.

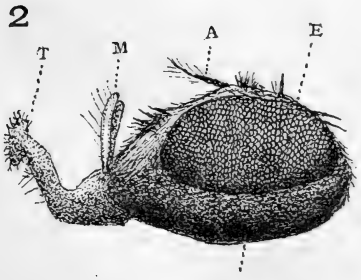
BY CHRYSANTHEMUM.

XIX.—THE HOUSE-FLY.

There are many kinds of two-winged flies which frequent our houses and gardens, yet few of us know their names,







their habits or how wonderfully they are made. Once we take the trouble to examine minutely these little insects, the humblest or more common, we shall feel that

we have made a new acquaintance and ever after when we see one of them in house or garden we can say: "Now I know you." These two-winged insects belong to the class Diptera which is composed of twenty-eight families. The house-fly, the blow-fly, the horse-fly, the mosquito and others with which we are familar belong to this class.

The little house-fly (Fig. 1) is called *Musca domestica.* But it is now midwinter and where shall we find a fly? Go to some place where meat is sold or to some out of the way hiding place. A last summer's fly may still be clinging to a spider's web or to the wall. If not dead, kill it by putting it in a large-mouthed bottle containing a little chloroform.

Now open the Excelsior microscope described in the last number and arrange it as shown in the Dec. frontispiece, placing the flat side of the glass stage G up, and the smallest of the lenses F nearest the glass stage. Put the instrument near a window with the mirror toward the light; turn the two largest lenses so they will come directly over the mirror and put the case containing the small lens and the diaphram at right angles to the lenses so that it will not interfere with the moving of the screw in the stage. Now slant the mirror so that on looking through the lenses you will have a white field. Place the fly on the centre of the glass stage, as though he were walking, and having loosened the screw in the stage, move the stage up and down very slowly until you can see the fly distinctly, and then fasten the screw. This is focusing the instrument. As the fly is quite thick and the light comes to a focus at one point only, you will not be able to see all parts with equal distinctness, but look at the head and back first, then focus again for the legs. With a little patience and practice you will be able to get a good focus quickly.

To have a microscope well lighted and in proper focus

is of the greatest importance. If the stage does not move easily, remove the parts from the rod and wipe the rod with an oily cloth, being very careful not to soil any of the parts, especially the glass. If any thing should soil the lenses wipe them with a clean, soft linen handkerchief, kept especially for the purpose, for a scratch on the lens would mean a line across every object seen through it ever after. There is one difficulty with this little instrument,—it is so light that it moves easily and disarranges the object. To obviate this take a piece of smooth board four inches by six and an inch thick and with one little screw fasten the case to the center of the board. This will make it quite firm. As the fly is an opaque object, if your light is strong sun-light, you can use the dark background which should then be turned so as to hide the mirror but better results can be gotten with the mirror turned so as to show a light field but not a bright one. The fly will be magnified about thirteen diameters. We will first learn the position of each of the parts, separately.

The redish brown spots on either side of the head (Fig. 1, E) are the eyes. Between the eyes the head is covered with short yellowish and black hairs and just at the front of the head are what look like two tufts or long black hairs. These are the antennæ (Fig. 1 A). The head is joined to the body or thorax, by a very short neck, and, if you watch a fly, you will see that he seems to have the power to turn his head quite around. The thorax is covered with the yellowish and black hairs in stripes, and to this are attached three pairs of legs, two wings and the abdomen.

Now move the stage up a very little so as to bring the legs into focus. These consist of several joints. There is one which joins the body and that we do not see called the *coxa*, next comes the *femur* or thigh,

B, then the *tibia* or shank, C, then the *tarsi*, D, (these are small joints just above the foot,) and the foot, F, which shows two little hooks. In securing the fly some of the parts may have been destroyed or they may be in such a position as to be hidden by some other part, so it is well to look at several until you can tell each part readily. In this position the tongue or proboscis is not visible. In order to see this, place the fly upon its side. At the front of the head just below the antennæ will be seen the tongue, if it is extended. Fig. 2 is a sketch of the head of a fly with the tongue, T, very much extended. It does not often show as much as this. The figure also shows the palpi.

Take all three of the lenses together using the little diaphragm and place the fly on its side with the head on the center of the stage and the tongue towards the light, move the stage up very slowly and when there is a good focus, fasten it. The object seems now much nearer to the lens than before, this is due to the higher magnifying power which is now about thirty diameters.

The diaphragm is used to shut off a part of the light so as to show the object more distinctly, and it makes the field smaller. Now look at the redish brown oval spot, (Fig. 2 E) and you will see the little hexagonal lenses of which there are 2000 in each eye, arranged very much like the cells of the honey-comb, (Fig. 5.) These are the parts of the compound eye and are each connected with the nerve of sight. Each part of this compound eye is so arranged as to form a perfect picture. Carpenter in his work on the microscope (page 908), gives a picture taken through one of these compound eyes. At A is one of the antennæ or feelers. This is composed of joints and by their number, shape and position, the genera and species of different insects are distinguished. The antenna of this fly has three joints, Fig. 4, but the first two are so small and near the body

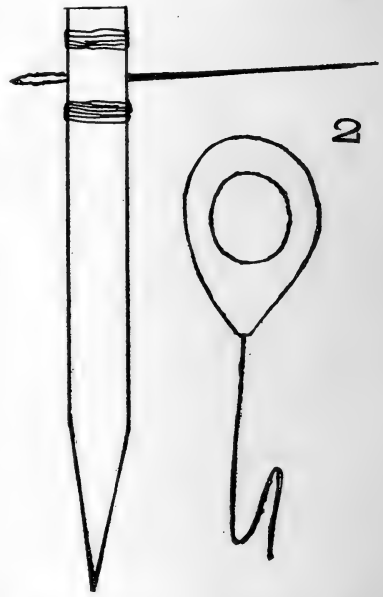
that we cannot see them. The last joint is covered with long hairs. An organ has recently been discovered in the antennæ of some insects which is thought to be the organ of hearing.

The tongue, (Fig. 2 T), is a broad fleshy lobe which is crossed with spiral fibers by which the fly is able to suck the juices it feeds on. There are little short stiff hairs set around the base of the tongue. It is these by which we are so much annoyed. M indicates the palpi. These correspond to the instrument that the mosquito uses to pierce the flesh of his victim when he seeks blood.

Move the fly so as to show his wings. If these are at the right angle they will show beautiful iridescent colors. Notice the veins in the wings, as their arrangement is important. Compare these with the wings of other insects. See along the outer edge of the wing the little row of hairs, then the beautiful net work of veins and in examining the wings of different flies, notice that the larger the fly the stronger and more numerous the veins. The wings of the *Musca domestica* make 600 strokes in a second, which carries it five yards and if alarmed it can fly thirty feet in a second. The veins in the wings we are told are hollow air vessels which communicate with the lungs, for even the little fly has lungs and an organ which acts as a heart to send the blood throughout his body and into his wings. He has also an alimentary canal, salivary vessels, biliary tubes, and a chylific stomach which seems to supply the whole alimentary canal with the power of digesting food. Flies have a crop or gizzard which is used chiefly as a reservoir for food when the insect takes more than it needs for its immediate wants.

The legs.—Take one from the body and arrange so as to see the foot. If you are to handle such small objects you will find a pair of pointed forceps necessary. These you can buy or make. Take two pieces of good elastic

whale-bone, three inches long and about one fourth inch in width, hold the end over the lamp and when it is warm it can be cut easily. Shape each piece nearly to a point as in Fig. 1, being sure to have them smooth at the points and of exactly the same shape. About one half inch from the other end cut a little notch in each edge having the notches exactly correspond when the pieces are put together, tightly bind the two pieces together by strong thread, putting the thread in the notches that it may not slip. Carefully bend the pieces so that the two points will stay one half inch apart.



Notice that the legs of the fly are covered with stiff black hairs and that these are quite numerous on the tarsi, and that the foot is furnished with two hooks (Fig. 3, H.) Under these hooks are two membraneous expansions or pulvilli, these are beset with hairs, and are in some way connected with its power to walk on the smooth surfaces in opposition to the force of gravity. Recent investigation has led to the belief that these secrete a gelatinous substance, the adhesion of which enables the fly to walk on the walls and ceilings and the two hooks are used to aid in detaching the foot, as we tear off a porous plaster, and the reason the flies remain hanging to the windows in the fall is because in their weakened condition they have not the strength to detach their feet.

The flies are great scavengers, feeding on all kinds of decaying matter and noxious gases, detecting them even before we do. In this way they are a great benefit. Notice the hairs on the legs, feet and tongue, take one of last year's flies, see the particles of dust clinging to the hair. Now will not the particles from the decaying substances upon which it feeds and bacilli of diseases cling to them in the same way? It is in this waythat he caries contageous diseases and he should be kept away from our food. When the fly is seen rubbing his legs together he is using the little hairs of the tarsi to clean himself from these particles.

If the microscope is used in the evening, you may find that the object does not show distinctly. This is because it is not properly lighted. It is best to use a small coal-oil lamp, having it six or eight inches from the mirror and shading the light from the eyes by a piece of paper hung to the lamp chimney by a bent hair pin and of such length as to allow the light to fall strongly on an object. This with the mirror turned so as to show a white field will give a good outline or show a transparent object well, but it is not sufficient for opaque objects. We need a condenser—something to throw a strong light on the object only. This can be made at home by getting at the opticians a double convex lens about the size of a coat button and cutting a piece of sole leather in the shape shown in Fig. 2, having a round opening in the center. With a sharp knife, divide the leather at the round end and around the opening so as to make a case for the lens. In the small end insert a wire about four inches long bent at the other end as shown in the diagram and insert this bent end in the center of a spool.

Place this between the lamp and the mirror and by moving it or changing the height by moving the wire up or down in the spool throw the point of light directly on the object to be seen. The dark background must

now be used. This will show the colors of the hairs and the iridescence of the wings.

It is not always possible to lay the object on the stage in just the desired position, but with a pair of stage forceps it can be held in any way. These can be bought, but Fig. 1 represents a pair made of whalebone which answer for a small instrument. Cut two pieces of whalebone as for the other forceps having two notches in the end instead of one. Wind with strong thread in both notches leaving a space between them, in this space insert between the strips of bone a large darning needle. By separating the bones a very little and bending the pointed ends toward each other you will have a pair of forceps which will hold an object. Having placed the object in the forceps with the part desired up, turn aside the stage of your instrument and stick the needle in the board in such a position that the object comes under the lens. Then by raising or lowering the forceps you can get the focus. These are very useful for looking at the small parts of flowers and in examining whole insects.

Buying a Microscope.

By H. M. WHELPLEY,

ST. LOUIS, MO.

The expense of ignorance is ever apparent to the observing person. In fact, every one realizes the cost of the bitter lesson taught by experience. We were made to realize this recently when called to examine a microscope which a druggist had purchased at an expense of forty-five dollars. The owner of the instrument was obliged to depend on the judgment and integrity of the firm from which he ordered it, as his knowledge of the instrument was limited to its name. As a result the druggist exchanged forty-five dollars for a microscope that we would not pay ten for, unless it was to have a cabinet specime of different styles of manufacture.

It is just as true as it is unfortunate that the market is flooded with poor microscopes which are being sold at extravagant prices. It affords us pleasure to say that they are not the product of American industry, but are brought to this country to satisfy that morbid idea that so many have which leads them to believe in the superiority of anything that is "foreign," and to rave over an article from Paris. It is not our intention to convey the idea that all foreign microscopes are of an inferior quality, for this is far from the truth. However, it is note-worthy that the Unites States manufacture fewer poor instruments than are imported for sale here. In fact, there is no necessity or even a good valid excuse for a pharmacist purchasing anything but an American microscope.

A word of advice anent the subject of selecting a microscope for pharmaceutical work may not be amiss at this time. Students at colleges of pharmacy, and those druggists who live in cities where such institutions exist, should embrace every opportunity for acquiring knowledge of the microscope as an optical instrument. This will enable them to select the microscope most suitable for the work and within the range of their means. Do not invest less than twenty-five dollars, and if possible expend fifty or seventy-five dollars for an outfit.

Those who are so situated that they cannot become familiar with the microscope and be their own judge must depend on others for a selection. Their opticians, as a rule, are not microscopists, much less pharmacists, and their judgement is often materially strabismic from the effects of the profit influence. To them the best microscope is the one that costs them the least and sells for the highest price. It is far better for a druggist to consult some competent microscopist and place his order accordingly.—EDITORIAL IN *Meyer Brothers' Druggist*, January, 1895.

A Few Suggestions to Novices in Photo-Micrography.

By NELSON B. SIZER, M. D.
BROOKLYN, N. Y.

From various quarters appeals for help so often come, that I trust a few practical hints may not, at this time, be *mal a propos* to the many amateurs who have yet to take their first photograph with the microscope.

To such, let me repeat with emphasis: One of the most important things is, to see that the sensitive plate is rigidly secured in a position accurately perpendicular to the optical axes of the apparatus both vertically and horizontally.

To secure this essential condition, measure the length of your expanded camera in inches, which for general use, may well be a quarter plate or 5x4. Next, incline your "scope" till horizontal, and measure its length from the upper end of the eye-piece to the end of the arm that carries the mirror. Then allow, say, 12 or 14 inches for room for your lamp and condensing apparatus, and add the three measures together. The sum will be the least useful length of your base-board.

To make this most essential part of the apparatus, procure a nice piece of pine board, truly parallel, about $\frac{7}{8}$ or 1 inch thick and the width of the camera exactly, its length being decided as above.

Fasten a thin hardwood strip to each edge, projecting $\frac{1}{2}$ inch above the upper side of the board; this will allow the camera to be freely moved lengthwise but keep always its axis parallel to the edge of the base.

The camera may now be expanded and its base-board fastened firmly to the base, so as to allow the bellows to freely play, but to prevent undesirable lateral motion.

Take out, now, the "lens-board" of your camera, and fit in its place a new one, made of thin pine, or "cigar-box" cedar if more convenient. Now mark upon the new front the point opposite the centre of the plate during

an exposure, and these two points must be put in the optical axis of the objective and ocular you use. For locating this point, cut an old mount and fit it in the plate-holder, like a sensitive plate, obtain its centre point by intersecting diagonals and here make a pin-hole. Put the card-board in your holder, draw both shutters and put the holder in place, closing the bellows up as far as it will go toward the front board, and mark the new board by a long needle put through the hole in the card, and kept perpendicular to the surface of the latter. You may now use the mark on the new front as the centre of a hole to be cut for the microscope tube to enter, and to be at least twice as large as the eye-pieces to be used in it.

To connect the parts light-tight, make a conical bag of velvet or of similar stuff; the larger end too big to go through the hole in the front, and the smaller end fitted to easily go over the eye-piece of your 'scope, the length being $2\frac{1}{2}$ to 3 inches. Pass the bag through the front board and tack or glue its larger end thereto, to be light-tight. The lesser end fits over the eye-piece end and is secured by an elastic band or its equivalent. This gives us a light proof but movable connection between the camera and the microscope.

To insure the coincidence of the optical axes of the two parts of the apparatus above mentioned, proceed as follows: Having found and marked the centre point of the new front board of the camera, put the microscope in its place on the board, the latter being on a table and made level accurately.

Now incline the tube of the microscope until horizontal, as shown by a small level placed thereon. Gently move your 'scope until the eye-piece end presses against a front board, on which you are to trace the outline of its circular milled flange. If you find the hole and circle central, very well; if not, the microscope as a whole must be raised or lowered until its optical axis is coincident with

that of the camera. It will facilitate things to draw a centre line from end to end of the base-board.

To insure steadiness, hold microscope rigidly in place by its base, cutting holes, if necessary, for the feet, and fastening all down by padded cross-strips of wood held by screws.

Similarly centre your illuminating apparatus and condensers, so that an eye placed at the centre of the plate could look directly through and see the ocular, objective, condensers and flame all in one and the same straight line.

To secure freedom from jarring and vibration, which spoils too many fine negatives buy three of the hemispherical rubber balls with screw attached, sold by all hardware and furniture men to screw into furniture to keep it from marring the wall and woodwork. Make legs of these, putting them in the under side of the base, two under the back of the camera, close to the edges of the board, the third at the centre of the other end. On these three legs the apparatus will stand firmly, even if the table-top, on which it is placed, may not be absolutely flat; vibrations also being absorbed, so that a passing "L" train, or beer truck will not disturb the work.

I have already referred to the joint between the 'scope and camera, and now only add, that while light-tight, it is also flexible enough to allow focussing.

Eye-pieces may be used, or not, as found best, under conditions described in technical treatises on the subject but it is absolutely requisite that every reflecting point throughout all the apparatus must be suppressed, or fog will result, as exposures are naturally somewhat prolonged. This may be well done by rubbing up lamp-black lacquer until a spot touched therewith shows a uniformly dull surface, with no reflection whatsoever when dry.

Having dabbled in such work for more than twenty years, I have met and overcome the most technical

stumbling-blocks which amateurs are apt to encounter in photo-micrography, and I find an absolutely essential point to be the keeping of all the apparatus in a straight line. Unless this is secured, the most elaborate apparatus and most careful focusing are but in vain, for otherwise, if one edge of the field is sharp, the other goes out into "fuzziness," and an even, sharp focus is a physical imposibility.

One caution. If using "apochromatics" never expect to see a flat field, for the objectionable roundness noticed in ocular observations will be doubled or trebled in a long-focussed camera. The obvious and only remedy is: Carefully put what you want to photograph in the centre of the field, and use a large-sized plate, so that you can afford to stop off the edges in printing your positives. In this way the curvature will not be offensive.—*The Photographic Times.*

An Examination for Blood.—The Bishop of Versailles, Monseigneur Goux, has submitted the famous seamless coat which is preserved as a relic in the church of Argenteuil and which according to tradition is stained with the blood of Christ, to examination by scientific experts. For this purpose he chose M. Philippe Lafon and M. J. Roussel, who were asked to furnish an answer to the following question: "What is the exact nature of the spots on the garment known as the Holy Coat of Argenteuil?" These experts in due course certified that they had made a chemical and microscopical examination of the "Holy Coat." After describing in the ordinary way, the tests employed, they sum up (according to the *British Medical Journal*) as follows: "From the portion of the Coat marked with rust colored spots we obtained: (1) A faint green coloration, with the tincture of guaiacum and the essence of turpentine, (2) the revival of the red globules of blood, with the artificial serum, (3) the formation of crystals of hæmin, or of chlorohydrate of hæmatin. These indications are sufficient to enable us to affirm that the spots examined are actually due to blood—and to human blood. Judging by the whole of our analysis, we presume that this blood is very old.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Foreign Microscopes.—On another page will be found Dr. Whelpley's opinion of foreign microscopes,—that while some very bad ones have been brought over here, there are others which are excellent, but that after all there is little or no excuse for buying imported instruments.

While publishing his views, it has seemed best to us to distinctly assure our readers that none of the worthless instruments alluded to are advertised in our columns. We are sure that our readers may trust quite fully the firms which advertise with us. We know from a personal tour through the shops of Watson & Sons, in London, that everything about their work is first-class and that they take the greatest pride in maintaining a high reputation.

Of course we desire to see home industry thrive and we believe that Bausch and Lomb, Zentmayer and some others make very fine instruments; but, dear reader, if you can get a better bargain from Watson, than from our own makers, do not hesitate to do so. Moreover, as Dr. Whelpley suggests, have the aid of a competent microscopist in deciding which is the better bargain. Let not sentiment either regarding the patronage of home products or regarding the superiority of whatever comes from Europe, have any weight with you in buying. Seek merit and a bargain.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

214. *Can you give me the addresses of Messrs. Powell & Lealand and R. & J. Beck of London, as I desire to obtain the catalogues of the above firms?*

R. & J. Beck, Manufacturing Opticians, 31 Cornhill, London, E. C., England. Powell & Lealand, Manufacturing Opticians, London, England.

215. *Of whom can I obtain the Stephenson Erecting Binocular Dissecting Microscope, described in Carpenter's work on the Microscope?—H. L. B.*

John Browning, Manufacturing Optician, 111 Minories, London, E., England.

216. *What method will harden in the shortest time, tumors or histological material?—J. R.*

Absolute alcohol will harden small pieces of tissue in a few hours, but may produce much shrinkage or distortion. Try Fol's solution:

Picric acid. Saturated aqueous solution,	10	parts
Chromic acid, 5 grains to one oz. of water,	25	"
Water	65	"

Mix.

It will harden small pieces of tissue in 24 hours. The picric acid stains the tissues also, but other stains may be used if desired.

217. *How shall I proceed to collect and examine the impurities floating in the air of a work-shop?—E. A. B.*

The floating dust, etc., work-shops and school-rooms may be caught in this way. Prepare slips of glass by smearing a small area with glycerine. Place these slips in different places about the room during working-hours. Let them remain during the night so that the floating particles may fall upon the glycerine and be retained. Add more glycerine if necessary, cover, ring with varnish and examine.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,

CLEVELAND, OHIO.

Metallic Globules.—Very interesting and pretty slides may be made from condensed volatilized metals. Gold that condenses from the melting pots of the mint forms microscopic globules of gold. On the roof of copper-smelting works a fine black appearing dust is found which under the 'scope is shown to be globules of metalic copper and when viewed as opaque objects exhibit the light red metallic lustre of copper. Many of the globules are hollow.

Vertical Illuminator.—This accessory is of very limited utility. In the hands of an expert manipulator it will grandly show the lines on an opaque silver-plated Amphipleura pelucida and will reveal a few other opaque objects with high powers. In the hands of an amateur it is but an aggravation of spirit. It does not work at all satisfactorily with dry lenses. It is suitable only for objects mounted dry on the cover and with immersion lenses.

Daphnilla Tuckermanii.—When a filtering of water supply from the Great Lakes is poured into a glass most of the diatoms and the heavier material fall to the bottom but little specks are always found floating on the surface. The specks generally contain some of the most interesting and wonderful forms in the gathering. In this way I recently had the pleasure of obtaing this strange and complicated Crustacean. Remove the specks with a spatula to a cell, cover and examine with an inch objective. The little thing was so interesting that I mixed glycerine with the water and mounted it permanently.

An Elegant microtome.—Possessing an old fashioned section cutter, that cost $15 some years ago, and finding that, in my hands, it was absolutely worthless for any fine or accurate work, I committed it to the tender mercies of a scientific young machinist.

He made a very heavy iron casting with a V shaped opening, into this he inserted a V shaped sliding portion for a knife carrier; firmly attached the old section cutter to the heavy casting; furnished brass screws and clamps. When a proper knife was screwed to the carrier, the old section cutter was transformed into an elegant accurate and efficient modern microtome and at a trifling expense.

THE MICROSCOPE.

FEBRUARY, 1895.

NUMBER 26. NEW SERIES.

Objects Seen Under the Microscope.

BY CHRYSANTHEMUM.

XX.—ROTIFERS.

The water of our ponds and rivers is peopled with many forms of minute animal life, and even the weeds

in a tank with gold-fish have among their branches some very interesting little animals. Take a small piece of the plant, that which looks old and brown being the best.

Put it on the stage of the Excelsior (or other) microscope, add a drop of water, and place over it a cover-glass. With the three lenses together, focus sharply. Examine the leaves very carefully and having found a little brownish object that looks like Fig. 1. a, b, c, or d, watch it attentively and see if in a few minutes the shape of the head will not change, or it may move or disappear with a jerky motion. At times Rotifers are seen sailing in the water or crawling curiously. These animals are so small and sometimes so hidden under the leaves that they are difficult to find, but once seen they will be readily recognized.

Fig. 1. a, b, c and d, represent Rotifer vulgaris as it is usually seen among the leaves. This species has a soft, transparent body, a head (Fig. 2. e.), two ciliated wreaths, f, two eyes, g, a mastax or apparatus for grinding its food, h, an alimentary canal, and a foot, k. The extremity of this foot is forked and secretes a gelatinous substance by which the animal is able to attach itself. The foot is so arranged that one part can be drawn inside the other like a ship's telescope. At Fig. 1. b, the animalcule is attached to the leaf by his foot, and his antennæ are extended in search of food. When food is found he expands the ciliated wreathes and sets them in motion. This makes a current in the water and draws the food within reach. It is then sucked into the mouth. This current can be seen and by it the Rotifier can often be discovered. These ciliated wreathes are two cup-like bodies surrounded by cilia or hairs, (Fig. 2. f). The slapping of these hairs one against the other gives the appearance of a rotary motion, and from this motion they receive their name. When not in use these wheels can be drawn into the body, giving the head the shape shown in Fig. 3. m. Some of the Rotifers can detach themselves and swim, using these ciliated wreathes as propellers. The Rotifer vulgaris has a peculiar way

of crawling. They attach themselves by the head, shorten and broaden the body and draw in the foot. Then fastening themselves by the foot again, they elongate the body to its full extent and repeat the process. The body of the Rotifer is so transparent that the action of the mastax and the motion of the food in the body can be seen with a high power instrument and with this instrument the movement of the water in the body can be seen.

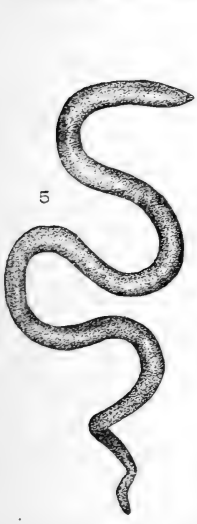
These animals are said to produce three kinds of eggs, a male, a female, and a kind that can be dried up and remain for a long time, and then under favorable conditions they may hatch. It has been proven that these eggs sometimes float in the air. If the water in which the Rotifer lives, dries up very slowly, the animal rolls itself into a ball, covers itself with a gelatinous substance which hardens aud retains sufficient moisture to keep the animal alive for a long time. Under favorable conditions it becomes active again.

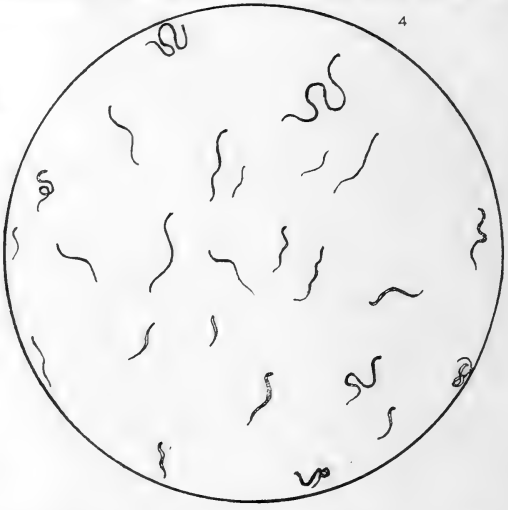
XXI.—Vinegar Eels.

Some pure cider vinegar which has stood for a long time will probably contain the Anguillulæ aciti, or vinegar eels. With a little pipette, such as is used for dropping medicine, carefully take from the bottom of the vessel a little of the vinegar and place one drop in the center of the flat side of the stage, being sure to have the glass perfectly dry, or otherwise the liquid will spread over the glass and not be of sufficient depth. Place the two largest lenses together, arrange the mirror to show a bright field and focus carefully. Some small thread-like bodies will probably be seen wriggling about actively. These are the vinegar eels, Fig. 4. With the two lenses they appear to be from $\frac{1}{4}$ to $\frac{1}{2}$ inch in length, but with the three together, a large one will appear to be from 1 in. to $1\frac{1}{2}$ inches in length. Look at one that is

near the edge of the drop, where the liquid is shallow and its movements are not so active. Notice that it is shaped something like a snake, with one end rounded a little, Fig. 5. These eels do not have a true head or any organs of sense, but are like worms. After the vinegar has evaporated somewhat, a few may be seen curled up and quiet. Carefully add just a small drop of the vinegar and watch them. Soon they begin to move, at first very slowly, then they become active again.

Turn the stage over the dark back-ground and look at





the drop without the lenses. The eels can be seen moving about as little white specks. This shows how much more can be seen by careful observation after one has learned what to look for.

These animalcules are also found in sour paste. If the paste in which they are seen be allowed to dry up and then after a long interval a small piece is added to some fresh paste, in a day or two the whole mass will be swarming with these creatures.

Another species is found in wheat affected with "cockle." If a grain of this wheat, which looks like a black pepper

corn, be cut open it will be found to be filled with a white, cottony substance. Soak this for an hour in water and then place a little under the microscope, add a drop of water, place over it a cover-glass (which is a circle or square of very thin glass made for the purpose), and there will be seen a wriggling mass of eels. The anguillulæ are entirely harmless to man.

Some Easy Experiments.

By FRANK T. GREEN,
SAN FRANCISCO, CAL.

Many branches of study are anything but pleasing in the abstract. Microscopy is one of them. In order to appreciate the study in its truest beauty, one must study closely nature's infinitesimal details.

Berry Benson tells of a man, "lying on the grass peering at it and among it, studying it curiously and intently with a magnifying glass. His friend passed by and asked; 'what are you doing there?' Said the man, 'I am traveling in a foreign land.'"

Just so with the microscopic worker, whether he be a child from school or a teacher—versed in the study of the infinitely little. For it opens a new field, yes, "a foreign land" to the investigator, the teacher and the child.

One of the greatest drawbacks to any study or any occupation is an unfortunate introduction. If the student first hears of microscopy as the art of slicing tough and horny roots into sections of transparent thinness, and failing in this, then trying it over and over again to his sorrow, he naturally will bear a grudge against the science. Better by far have him reach out for something easier of attainment, and yet giving rare chances of learning the detail of little things from actual observations.

If anyone will take a shaving of wood thrown off

by a sharp plane, cut it into a neat little square, say one-quarter of an inch, wet it with turpentine, in order to drive out the air, also rendering it transparent, then immerse it in prepared balsam, putting it on a slide, and slipping on a cover-glass, he will have a most beautiful section showing the long cells with the lenticular markings or bordered pits, if it be from one of the pines or its relatives. He can see how nature employs the medullary rays, diverging from the pith to the bark, as the woof. with the warp or vertical woody tissue, in order to weave that network of ligneous cells combining flexibility with strength. A section of redwood shows the horizontal cells gorged with brilliant ruby-colored resin. A few years ago, I noticed on an apple box a narrow board showing successively the colors, white, cream, yellow, red and brown, all in a width of half an inch. I still have the shaving, mounted, and it is pretty, indeed, to observe how the resin cells increase in number and depth of color, thus giving this California cedar its deserved name of redwood.

The pappus from the dandelion is very easy to mount and is well worth the time. On a clean slide describe a circle a little smaller than your cover-glass, say seven-sixteenths of an inch in diameter, using a turn-table and employing a small camel's hair pencil wet with colorless balsam. In the central space, which is dry, put a seed or pappus of any small compositæ, cover it, pressing down the glass gently; it will then adhere to the first ring. When dry, ring again on the outside edge with colorless balsam. You will have a delicately beautiful slide—and one to be proud of—mounted in air, as the microscopists say.

The Chinese shavings sold in the shops make an ideal longitudinal section all ready to mount. The epidermis of any leaf shows the stomata or breathing pores, if simply wet with alcohol, then turpentine, and lastly,

mounted. If you use the polarizer with it, you will find it equal to double staining as regards the distinguishing of different tissues.

Fuller's earth, tripoli and electro-silicon show scores of silicious forms beautifully symmetrical all classified as diatoms or other organisms by the scientists. Lupulin, lycopodium and starches all have a structure which the microscope reveals clearly.

Put a drop of pure comb honey on a slide some time, cover it, and when magnified you will see grains of pollen which have fallen from the broad and fuzzy backs of the indefatigable little workers, the bees. As an analytical point in the identification of honey, you can remember that the artificial honeys show no such companionship, for that honey is as far away from the pollen-laden flowers as it has been from that busy little community, the bee-hive.—*Pacific Druggist.*

Mounting in Canada Balsam.

By NO SIG.

Every one after having prepared his objects or sections, is desirous of preserving them in a permanent form in as neat a manner as possible and that with the least trouble. The following manner of proceeding will assist in obtaining good results.

Turn a circle on the back of the slide in ink with a pen, being careful that the circle is rather smaller than the thin glass it is intended to employ, so that the refraction of the balsam at the edges of the glass do not interfere with placing it true in the center; the best turn-table to employ is the concentric turn-table, made by Aylward, of Manchester, Eng. The slides must always return absolutely to the same center.

When the ink is dry, wipe the front of the slide well with a clean cloth, and press or drop two or three drops

of balsam or balsam dissolved in benzole in the center of the glass slide, take your object out of the turpentine it is soaked in, with a small pair of pliers, and place it in the balsam with the hollow curved side of the preparation down if it is not quite flat. Then turn it over on the other side to release any air bubbles that may be en closed underneath, then adjust it well in the center with a needle point, put a drop of balsam on the top, and place the slide on one side protected from the dust for 24 hours.

Clean a cover-glass the size you wish to use, see that the preparation is well centered. If it is not right it can be moved by the needle point, the balsam not being hard enough to prevent it, but if the preparation is very delicate, it will be necessary to warm the slide on the hot-table to soften the balsam before attempting to disturb it; when everything is right, place a drop of balsam on the top. This is to fill up any hollow that may form in the center of the balsam, which would hold the air when the cover is put on it. Place the cover gently in the middle of the slide, letting it sink down by its own weight at first, press gently with the needle, being carefulto have the cover properly in the center. If not quite centered, shift it with the needle point till it is quite true. The preparation will not move in the balsam for some time till the fresh balsam has penetrated through the dried balsam put on the day before. If you find that the object has moved out of the center then comes the difficulty of getting it back again without beginning the whole process over again. Have two needles by you, as one is sure to get messed with balsam which will get on the front of the cover-glass and bother you in centering the object. Notice to which edge of the cover-glass the object is nearest, and with the needle point draw the cover-glass by pressing on the top towards the edge of the slide. In this way the cover will slip over the

object without displacing it. Then push the cover back by the edge when it will take the preparation with it. In this way, by a little patience, the object can be shifted to any part of the slide. If you try to get it in the center by pushing the cover first from the edge, you will soon find that the object will work right out of the field. Having got everything right and true, put a light brass clip on to hold the cover in its place to dry. If you put too strong a spring on the preparation it may force the cover up when the spring is released. It is better to remove the surplus balsam with a knife, at once, while it is soft, wiping the balsam off of the knife with a piece of paper. Place the slide away for a few days to allow the balsam to harden, when you can clean off the slide with methylated spirit, or better with benzole. When the slide is nice and clean, put it on the turn-table and run a ring of gum water round the edge of the cover-glass. When dry, give it another coat. This is to prevent the white zinc or other cement being dissolved by the benzole and running in under the cover-glass. If pure balsam is used, there is much less risk of this occurring. A very neat finish is given with white zinc cement. It is easy to work and gives a good, hard, brilliant surface, on which can be put a ring of black or any other colored varnish. When you have finished, clean the brush well by means of benzole; wipe the brush on a piece of paper between the fingers first, when the brush can be cleaned with a very small quantity of benzole and very quickly.

The Serum Treatment of Diphtheria will be explained in The Popular Science Monthly for February, by Dr. Samuel T. Armstrong, Visiting Physician to the Hospital for Contagious Diseases, New York.

The article will be of much interest to bacteriologists.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

The Microscope and Public Health.—In Maine, 1513 persons die every year of tuberculosis,—an entirely preventable disease.

In New York City, 3673 more infants died in 1882 than in 1883. The milk was examined in 1883 and not in 1882.

Meat may be contaminated with micro-organisms either by exposure to flies or to street dust.

Meat from tuberculous animals is sold to our own people. That exported to Germany must be proven free from this disease.

Ninety per cent of the typhoid cases are due to drinking infected water. Boiling the water would render it harmless.

Last year, 455 persons died in Allegheny and Pittsburg from typhoid fever. This is nearly ten times the death rate of London, where the water is filtered through sand and other hygienic matters are looked after.

The microscope gives us adequate means for discovering how to remedy such evils as the above. It should be regarded as a crime for any physician to try to practice medicine until he is provided with this iustrument and knows how to use it. Public officials should be actively engaged in seeking the public

welfare, but the public office in America is now "a private snap" and the incumbents think how to make money out of it. Their actions mostly correspond with Vanderbilt's epigram,—"The public be d—d," and it often is—with disease and death.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

218. *Please inform me how to measure the value, or magnifying power of objectives and eye pieces?—Dalton.*

Col. J. J. Woodward's method is not very precise but simple and sufficient for ordinary purposes. Use an eye-piece fitted with a micrometer, but with the field lens removed. Place a stage micrometer beneath the objective. When in focus, the two micrometers must be at least 10 inches apart. Then the true focus of the objective will equal the magnification multiplied by the distance and divided by the square of the magnification plus one. Suppose when adjusted as above, that one division of the 1-100 inch on the stage micrometer, at 10 inches distance, appears to cover 18 divisions of 1-100 inch, of the eye-piece micrometer then 18 multiplied by 10 and divided by the square of 18 plus 1; equals 180 divided by 361; equals .5 or one-half inch, the focus of the objective. If one uses a positive eye-piece, in which the micrometer lies below the field lens, the latter need not be removed. See A. M. M. J. 1885, page 141, for more accurate methods for finding the optical center and rating of an objective.

The following approximate method will enable one to determine the magnifying power of an ocular. Use an objective of known focus, i. e. power, and a tube length that will place the optical centers of the eye-piece and objective ten inches apart, as nearly as possible. Place a stage micrometer in position, turn the microscope body to the horizontal and place the instrument on a box or on blocks to raise the center of the eye-lens just ten inches above the table. Slip on a camera lucida and compare the image of the micrometer ruling with an inch

rule. This will give the magnification of the combination. Then the combined power divided by the known power of the objective will give the power of the eye-piece. Prof. J. Edwards Smith, in his work, "How to see with the Microscope," gives the true magnifying power of single convex lens at ten inches, as follows :

One inch equals 8 diameters; ½ inch equals 38 diameters; ⅛ inch equals 58 diameters; 1-10 inch equals 98 diameters. An objective properly rated, of 1 inch focus, should magnify 8 diameters, and with a one-inch eye-piece at ten inches, should magnify 64 diameters.

219. *How may the owner of a small aquarium like that of Tempere, learn to identify the forms?—Dalton.*

Stokes' Microscopy for Beginners—price $1.50—will give the needed information. It tells all about life in our ponds and ditches.

220. Where can I obtain the latest edition of Griffith and Henfrey's Micrographic Dictionary?—I. H. H.

The Micrographic Dictionary is published by John Van Voorst, Paternoster Row, London. It is listed by Bausch and Lomb Opt. Co., Rochester, N. Y., at $20.00 net.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

Magnification.—Mere amplification of an object is useless for nearly all purposes. Definition and disclosure of detail are of scientific value. Never use upon an object a higher power than is necessary to show it well.

Killing and Preserving Delicate Organisms.—Perchloride of iron is one of the best agents for this purpose. The organisms referred to are such as Rotifer vulgaris and other ciliata. With this agent the animals are fixed very perfectly in their expanded condition nicely exhibiting their cilia. For ordinary use a solution in alcohol containing about two per cent of the compound should be used.

The animals may be placed on a slide without cover and the

solution dropped over them. When it is desired to obtain a large number of the organisms, they may be killed in a vessel and then a stronger solution must be used. In the vessel, the animals will fall to the bottom; the water should be drawn off above them. Then add seventy per cent alcohol and replace this with alcohol slightly acidified with hydrochloric acid. This latter solution should be run over the animals fixed upon a slide. The effect of the latter solution is to remove all trace of the iron salt. This should be immediately drawn off and pure alcohol added. The animals can then be mounted in glycerine.

Mounting Hydra.—Hydra viridis is nearly always to be found on the under surface of the leaves of Lemna. It is also found adhering to other plants. For an acceptable mount it should be prepared so as to exhibit its expanded tentacles. The following is a method by which this may be accomplished. Have a slide with a well dried cell of sufficient depth; drop the hydra on the end of a plain glass slip. Hold the slip near the top of the chimney of the student lamp. You can see then if its tentacles are expanded. If they are, quickly hold the slip with the hydra over the chimney end about an inch above it. Hold it there from three to five seconds; then quickly place the slip upon a cool, heat-conducting surface. When cold transfer the animals to the prepared cell and mount in glycerine. All kinds of hydra and many other of the larger zoophytes may be fixed and mounted in this manner.

How to Examine Coal.—Coal is of vegetable origin. To examine its structure it is necessary to have very thin sections. To obtain such sections, macerate the coal for about a week in a solution of carbonate of potassium when thin slices may be cut with a razor or a microtome. These sections should be gently heated in nitric acid, and when they turn yellow, should be washed in cold water and mounted in glycerine. Spirit or balsam will render the sections opaque.

SCIENCE-GOSSIP.

Drinking Cups and Diphtheria.—Dr. Chas. H. Stowell, formerly Editor of *The Microscope* says of Washington Schools;

A few days ago I was greatly surprised to learn that the old drinking cup was still in active use in our schools. This is such a total disregard of all ordinary precautions for the prevention of disease that it hardly seems possible. Yet in one of our largest schools there are just six of these tin cups used by the whole school for drinking purposes. Now it is a well established fact that diphtheria is caused by a specific germ. It is also well established that this germ may reside in the throat some time before the symptoms of diphtheria appear. Recent investigations on this subject in New York City showed that a small per cent of the children examined had this cause of diphtheria existing in the throat, and yet did not exhibit any of the symptoms of diphtheria at the time of the examination. Some of the secretions from the mouths of such children, if carried to the throats of others, would quite likely cause this disease. When diphtheria is present in this city it would not be at all surprising to find that in a large school there would be a small per cent of children who could communicate this disease to others.

And yet, the school trustees allow a tin cup to be passed from one mouth to another! The use of a common drinking cup by a number of school children should be relegated to the ignorant methods of the dark ages. Not a cup should be provided by the school authorities. Each child should bring his own cup. You cannot do anything better than to forbid this promiscuous use of the drinking cup.

CORRESPONDENCE.

How to find Diatomaceous Earth.—Mr. W. A. Terry of Bristol, Conn., sends us the following:

It is asked how we know when we have found Diatomaceous Earth? It is of course impossible to be absolutely certain until the find has been examined under the microscope, still a collector of experience and good judgment will make few mistakes. The fresh water deposits are almost invariably covered by a layer of muck or peat. A light-colored stratum below muck will be either *lime*, *clay*, or *diatoms*, if it is not *sand*. Sometimes *all* mixed. If the material dries of a light gray or ash color and is also light in weight, it is almost certain to be rich in diatoms.

If the deposit is heavy, it is mostly clay or exceedingly fine silicious dust; it is always well to examine all such deposits under the microscope, and, if not rich they may contain rare varieties.

The marine deposits underlying the peat of all salt marshes of the Atlantic coast always contain diatoms; in some localities these are comparatively rich, and frequently contain deep water forms. The diatoms are not equally distributed through these deposits, but are apt to lie in thin streaks or in pockets; and strata holding shallow water forms and those containing deep water kinds are sometimes in close proximity. Where ditches have been dug through these marshes for drainage, material containing very interesting varieties is frequently thrown up. Shallow water kinds usually predominate near the surface, and below are streaks of deep water forms alternating with those of brackish water down to a depth of over twenty feet in many places.

On the New England coast, it is not very unusual to find these deposits to be from thirty to fifty feet in thickness. Where the deposits were laid down by strong tidal currents, few diatoms will be found. They deposit in eddies and basins after the coarse sand has been left behind.

These hints will be sufficient to guide the efforts of persevering and intelligent investigators in search of Diatomaceous Earth; but they must understand that tiresome and disagreeable labor is inevitable if they would win success. At some future time I will give more detailed instructions.

TO THOSE WHO HAVE REMITTED FOR 1895.

We feel especially and unusually thankful to those who have sent in their checks during the past five weeks.

Like others, we are struggling with the "hard times" and your promptness helps materially. We cannot write personally to thank each one, but we take this means of telling you how sincerely we appreciate your thoughtfulness. In spite of the times, which we believe will change before mid-summer, we shall be able to increase the number of our illustrations during the year.

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FOR SALE.—A 1-20 inch homogeneous immersion objective by Gundlach, 1.20 N. A. Price $60.00. Maker's price $75.00
Dr. Alfred C. Stokes, 527 Monmouth st., Trenton, N. J.

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THE MICROSCOPE.

MARCH, 1895.

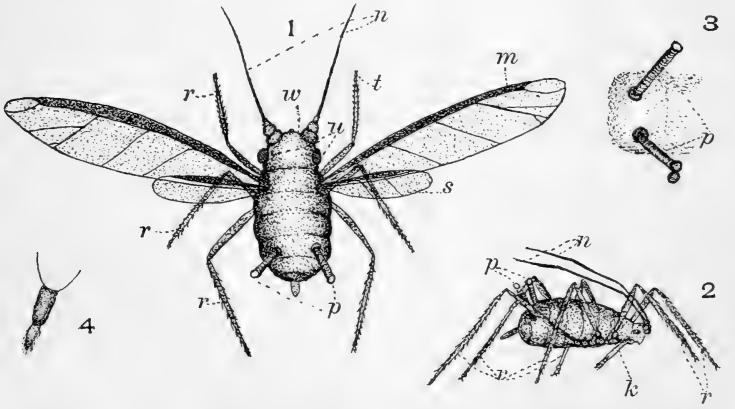
NUMBER 27. NEW SERIES.

Objects Seen Under The Microscope.

BY CHRYSANTHEMUM.

XXII.—APHIDES.

Almost everyone who cultivates flowers has seen the green Aphides or plant-lice, which are so troublesome on the roses, sweet peas, verbena and other house and garden plants. Perhaps a study of them and of their habits will make them more interesting if not less annoying.



With a dissecting needle or wooden tooth-pick transfer one of these insects to the center of a glass slide and with a pipette slowly and carefully drop a little alcohol on it. After a few minutes remove the alcohol that remains by touching the drop with a piece of blotting paper, which will absorb the liquid and if sufficient care has been taken will leave the Aphis in a standing position.

Observe that the head (Fig. I, *w*) is not separated from the body as in the fly, but that head, thorax and abdomen seem to be all in one piece; that it has two eyes, (Fig. I, *u*) one on either side of the head; that these eyes are compound; that the antennæ (Fig. I, *n*) which have seven joints are long and slender and when carried over the back reach beyond the body (Fig. 2, *n*); that the legs (Fig. 1, *r*) are six in number and they also are long and slender in comparison with the size of the body; that the tarsi (Fig. 1, *t*) have only two joints and that the legs are covered with delicate hairs. Viewed as an opaque object the eyes look like two deep rubies set on the sides of a somewhat oval emerald, the legs and antennæ like sparkling amber and in case of one of the winged Aphides; the wings show fine iridescent colors. Altogether it is a beautiful object.

On the back, toward the end of the abdomen, are two very slender protuberances (Fig. 1, p). These are the tubes from which exudes a sweet liquid which drops on the leaves of the plants, and is there known as honey-dew. To see this honey, take one of the glass slides containing a slight depression in the center, and carefully remove an Aphis to the center of this. Then place over it a cover glass and secure it with two or three small pieces of gummed paper, placing the cover so as to admit a little air. Put it under the microscope and in little while you will probably see either a drop on the honey tube (Fig. 3) or the drop where it has fallen on the glass. The little red ant is very fond of this honey, and is found on the plants infested with these insects. They not only eat the honey which has fallen on the leaves, but take it from the honey tubes. The ants make the same use of the Aphides as we do of cows. Some species of the Aphides live on the roots of plants.

Rusticus, in his letters, says: "Another odd station for the Aphides is on the roots of plants. The other day

I pulled up a large thistle that grew on an ant hill and found a whole colony of Aphides. I shook down some dozen of them among the ants. No sooner were the ants aware of the presence of the Aphides than they began to fondle them with their legs, sometimes positively taking them around the neck, to tap them on the back with their antennæ and to lick them with their tongues. The ants then took hold of them with their jaws and lifted them from the ground and carried them with the greatest care, one by one, into the recesses of the nest. I have often watched an ant go from one Aphis to another, stand behind each, and gently squeeze the body with its forelegs. Perhaps one Aphis in ten would give out a drop of honey, which the ant immediately swallows. The ants take much more care of the Aphides than the Aphides do of themselves. It is very pretty to see the licking and washing and cleaning and caressing which the ant constantly bestows upon them."

The Aphis lives on the juices of the plants which it inhabits. It is provided with a tubular proboscis (Fig. 4) for sucking these juices, and when this is not in use it is carried under the breast (Fig. 2, k), where it is seen with difficulty unless the insect be held in the stage forceps. The Aphides multiply very rapidly, the wingless insect (Fig. 2) producing young like herself, only smaller, and as many as fourteen in a day. The life of an insect is from two to three weeks, and it is said that a single Aphis and her descendants can produce as many as 23,740,000 in a single summer. Towards the end of summer the true winged males (Fig. 1) and females appear and lay eggs which hatch the following spring, thus perpetuating the species.

These insects are often destroyed by fumigation with tobacco, but nothing is more effectual than their natural enemies, the lady-birds. Not only do the adults feed on them, but the mother insect lays her eggs in packets

among the Aphides, and as soon as the young larvæ are able to move about they begin to feed upon them, and in a few days not an Aphis will be found on the plant. Some of the Ichneumon flies and other insects destroy the Aphides by laying their eggs in its body. The larvæ feed upon upon the insect and escape, leaving the skin of the Aphides brown and dry. These skins are often found, sometimes with a fungus growth upon them. The larvæ of the Ephedrus plagiator escape by a little hole in the side of the body, to which a circular door is attached by a piece of uncut skin. The larvæ of another insect escape by pushing off the three last segments of the abdomen.

A Model to Follow.

BY RENE SAMSON,
WASHINGTON, D. C.

Last October, I spent an evening in Paris with Mr. George Clifford the author of several articles in the micoscopical periodicals of Washington signed "No Sig" when he kindly showed me under the microscope the most interesting slides of his collection and explained to me his practical methods in microscopy which have been or will be described in these periodicals.

Mr. Clifford can certainly be called"a model to follow" for a beginner or amateur microscopist. I would have been happy to have had our readers admire this worker in science, enjoy an evening with his instruments and see with what methods he proceeds in everything.

The principal rules he follows are: The working table of a microscopist must always be cleared off. As soon as he is through with an instrument, a bottle or a book he must put it back in its own place. After using a brush it must be cleaned immediately, before puting it aside. Always wipe the neck of a

bottle after pouring a liquid. All his instruments are kept in a closet, out of the dust and in the most perfect order; if he needs one of them he finds it at hand, cleaned and ready to use.

All his slides, classified and catalogued, are kept in a splendid cabinet. Visitors are surprised when they learn that in that fine piece of furniture thousands of slides are contained, among which many have a value from ten to twenty dollars apiece.

Working as he does there is no need of a laboratory; a corner of the table of the dining-room is sufficient.

Mr. Clifford receives the best microscopical papers published in French, English and German. One department of his library is especially reserved for scientific works. Many of these books are the latest publications, many old and rare editions are to be found there also.

The great desire of all the young beginners, readers of this periodical, ought to be to own one day as he does a fine set of instruments, a beautiful and numerous collection of slides and a valuable library.

Our friend has been in Paris over twenty years being originally from England. He is a very warm personal friend of the Editor of this periodical who has visited him several times. Of course, he has complete files of the American microscopical periodicals.

The Value of the Microscope.—The value of a microscope to a druggist is shown by the following incident: A lady had procured from the stores pepsin much cheaper than she had been paying her family chemist, and complained of the surcharge. He obtained a specimen of the medicine, and was soon able to demonstrate to the customer by the microscope that she had paid too much for her specimen, for it was nearly all starch. She does not go to the stores for pepsin now.—*Chemist and Druggist.*

The History of the Royal Microscopical Society.

By A. D. MICHAEL,
LONDON, ENGLAND,

At the annual meeting of the above named society the president gave an address in which he said that if any of his hearers would leave that West-end abode of science and journey eastward to Tower Hill,and thenceby Sparow Corner along Royal Mint Street, he would find himself in Cable Street, St. George's in the East, not a very quiet or a very clean locality: turning down Shorter Street he would emerge opposite a space of green, where once stood the Danish church with its Royal closet reserved for the use of the King of Denmark when visiting this country. The space is surrounded by houses which have seen better days, and amongst them, between a pickle-factory and a brewery, stands a rather dilapidated erection which is 50, Wellclose Square; where, in 1839, lived Edwin J. Quekett, Professor of Botany at the London Hospital; and there, on September 3 of that year, seventeen gentlemen assembled "to take into consideration the proposition of forming a society for the promotion of microscopical investigation, and for the introduction and improvement of the microscope as a scientific instrument." Among the seventeen, were N. B. Ward—the inventor of the Wardian case, which is not only an ornament to town houses, but was the means of introducing the tea-plant into Assam and the cinchonas into India—who became treasurer of the Society; Bowerbank Lister, who has been called the creator of the modern microscope; Dr. Farre; Dr. George Jackson; the Rev. J. B. Reade; and the enterprising and scientific nurseryman, George Loddiges. Most of these subsequently became presidents of the Society. A public meeting was held on December 20, 1839, at the rooms of the Horticultural Society, then at 21, Regent Street, when the "Microscopical Society of London" was formally started.

Professor Richard Owen (not Sir Richard at that time) took the chair, and became the first President; and shortly after the famous John Quekett became secretary, an office which he held almost to his death.

At this moment Schleiden in Germany was commenting upon the paucity of British microscopical research, and attributing it to the want of efficient instruments, not knowing that a society was then forming which was to raise British microscopes to probably the first position in the world. The President then traced the history of the Society through the presidencies of Dr. Lindley, the botanist, Professor Thomas Bell, the zoologist, Dr. Bowerbank, Dr. George Busk, Dr. Carpenter, Dr. Lankester, Professor W. Kitchen Parker, all deceased; and of others equally famous who are still living; and showed how, under its influence and by its assistance, the vast improvements in the microscope, and the enormous extension of its use, had gradually arisen. He also described its connection with the origin of the "Quarterly Journal of Microscopical Science," the "Monthly Microscopical Journal," and other publications, besides its own present widely circulated journal with its exhaustive summary of microscopical and biological work. He related how on John Quekett's death certain members of the Society subscribed to purchase for the Society's collection a curious microscope which Quekett possessed, and which had been made by the celebrated Benjamin Martin about 1770, probably for George III., and how they extended their subscription so as to provide a medal to be called "the Quekett medal," to be given from time to time to eminent microscopists; and how, difficulties having arisen, it happened that the only Quekett medal ever awarded was given to Sir John Lubbock.

Finally the President considered the future of the microscope and the prospects of further improvements. He said that many people were of opinion that the ins-

trument is now perfect, and that consequently the most important *raison d'etre* of the Society was over; he by no means agreed in that view; he believed that there was as much scope for progress in the future as there had been in the past. It was not by any means the first time that this idea had been put forward. In 1829, Dr. Goring, then a great authority on the subject, wrote in one of his published works, "Microscopes are now placed completely on a level with telescopes, and like them, must remain stationary in their construction." In 1830, less than a year after, appeared Lister's epoch-making paper, "On the Improvement of Achromatic compound Microscopes," and we have been improving ever since.

Pharmaceutical Journal, London.

A New Peritrichan Infusorian.

BY T. B. REDDING,
NEW CASTLE, IND.

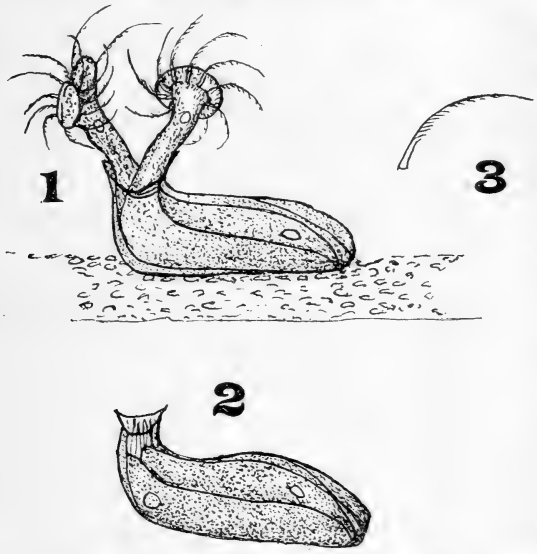
On the 17th of January, 1895, I found, on a filament of Vaucheria sessilis growing in a jar, in my green-house, where it had been at least eighteen months past, an Infusorian entirely new to me, though I have studied the Infusorians for more than ten years past and made hundreds of drawings of them.

I refer it to the order Peritricha Stein; sub-order, Sedentaria; sub-family, Vaginicolinæ; Genus and Species, doubtful.

The lorica is sessile, of a pale brownish color and membranous. Length of lorica 1-216; width 1-700; neck of animal, when fully extended, as long as body, or lorica, or nearly so; diameter 1-1,600; length of cilia various, from 1-700 to 1-900 inch; with two much longer. Opening of lorica 1-1050 inch wide.

There were two animals in same lorica, but whether united or not I could not determine, but I think not.

Cilia inserted under and upon the lower border of oral disk, as shown in fig. 1, and fringed on curved side with very fine serrations, as shown in fig. 3. When at rest cilia lie flat, curved upon the margin of the oral disk. The left hand disk, in fig. 1, appears double, the upper disk having two very long cilia, one on each side. Food was ejected through the upper and received into the lower opening. Figure 1 shows the infusorian with anterior parts protruded, and with cilia expanded.



Just below the oral disks is a contractile vessicle in each of the animals, pulsating once in 30 to 45 seconds. Also a vessicle in the body, as shown. On the slightest disturbance the animals almost instantaneously withdrew into the lorica. When about to protrude from the shell they appeared as in fig. 2, with cilia in shape of a pointed brush. No valve could be discovered.

Particles of food were easily seen passing down and up through the extended necks near center.

On examination the next evening the animals were dead, but the lorica was in good shape. They were kept over in a moist chamber under cover on slide.

I find several other species and genera of the Peritricha in this vicinity.

Mr. Redding would perhaps assist our readers about identifying forms they may find.—*Editor.*

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Economic Uses of Lichens. 1. Iceland Moss, Cetraria islandica, is boiled and eaten with milk by the Icelanders. Often it is their only food.

2. Reindeer Moss, Cladina is powdered and mixed with flour. It is an important food of the reindeer.

3. Tripe de roche, Gyrophorei, is eaten after being boiled by the Canadian hunters and Indians.

4. Manna lichen, Lecanora, has often been eaten by men and and cattle in Algiers and Tartary.

5. An alcoholic spirit is distilled from Cladina rangiferina in Scandanavia and Russia.

6. Sticta pulmonaria is used in place of hops in brewing.

7. The dyes, archil, cudbear and litmus are derived from Roccella, purple dye, Lecanora, red dye, Ramalina, Parmelia, Umbilicaria, etc.

8. A substitute for gum-arabic is obtained from Ramalina fraxinea, Evernia prunastri, and Parmelia physodes.

9. Perfumery has been obtained from Usnea, Ramalina, Evernia and Cladina.

10. Jaundice has been treated with Platrysma juniperinum.

11. Pertusaria amara is a febrifuge.

12. No lichen is poisonous.

Those interested in collecting Lichens will find a key to the genera in the American Monthly Microscopical Journal for

March, kindly prepared by our assistant, L. W. Willson, who is in charge of the Department of Practical Suggestions.

Where to Hunt Lichens. The following data are compiled chiefly from the Encyclopaedia Britannica, 9th Ed.

Lichens are never found on cultivated ground nor in atmosphere impregnated with smoke. They demand a quiet and exposed situation.

1. The rugged bark of old trees. (Ramalina, Parmelia, Stictei.)
2. The smooth bark of young trees and shrubs. (Graphideus, Lecidea.)
3. Trees by roadsides (Physcia) or in large forests. (Usnea, Alectoria.)
4. Decayed wood of trees and old pales. (Calicieus, Lecidea, Xylographa.)
5. Calcareous and cretaceous rocks. (Lecanora, Lecidea, Verrucaria.)
6. The mortar of walls. (Lecanora, Lecidea, Verrucaria.)
7. On calcareous, peaty, and argillaceous soils, and on hardened mud. (Cladonia, Lecidea, Lecanora, Collema, Peltidea.)
8. The sands of sea-shore and the granitic detritus of lofty mountains.
9. On decayed mosses and moss-like plants. (Leptogium. Gomphillus.)
10. Upon perennial leaves of certain trees and shrubs (Lecidea, Bouteillei, Strigula.)
11. On tombstones, old leather, iron and glass, on the bleached bones of reindeer and whales, on the dried excrements of sheep.
12. Parasitical upon other lichens. (Lecidea, Pyrenocarpei.)

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

221. *Is there any good work containing the classification of Bacteria and descriptions of methods of cultivating them?*

If you want the best, pay $10 for Sternberg's Bacteriology. If only the rudiments, we can get you Ball's Essentials of Bacteriology for about $1.25 postpaid, or for $2.25 we can order Reeves' Medical Microscopy which contains colored illustrations of Bacteria with descriptions and will besides give you lots of information about urinalysis, the blood, etc.—C. W. S.

222. *I wish to use mounted specimens and project the image through a microscope upon a screen.—Can I use a lamp or gas light for illumination?—W. F. Proschwitzky.*

You will require an oxy-hydrogen lime light or a small electrical arc light. The pencil of light must be small enough to pass through the small lenses of the objective and bright enough to bear the subsequent spreading out upon the screen.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

The Mounting of Sponge Spicules.—First place a drop of balsam on the center of the slide. Then sprinkle some spicules over the drop and cover with a thin glass. Then heat and boil until all bubbles disappear. Set away to cool and a good slide will be the result. The large spicules may be arranged and mounted as opaque objects and will thus make very beautiful slides.

Cleaning and Dismounting Slides and Covers.—Heat the slide with the cover over a lamp until the cover moves. Then remove the cover; soak cover and glass slip in turpentine. A drop on each will be sufficient. Then wash in a drop of alcohol and wipe with a smooth linen cloth. If it be desired to have the slides chemically clean, soak them in strong sulphuric acid containing some crystals of potassic bichromate, allowing the slides to remain several days in the liquid.

To Preserve Algæ.—Camphorated water and distilled water, each 50 grammes; glacial acetic acid, 5 gr.; crystallized nitrate of copper, each 2 grammes; dissolve and filter. Specimens thus prepared will retain their living appearance.

To Fix Cilia of Infusoria.—In a drop of water containing

Paramecia or other infusoria upon a slide, drop a minute quantity of tannic acid. If the solution is too weak, the cilia are not immediately arrested, but if the solution is of the proper strength they will stand out straight. After this treatment the infusoria appear beautifully with a paraboloid. The solution of tannin is made by dissolving one part of tannin acid in four parts of glycerine.

Collecting Specimens.—During March, April and May many beautiful specimens may be collected from ponds. Scrape off any gelatinous matter. For small animals use a small hand net, made of common cloth and troll this along the bottom. Such a net must not be more than three inches in diameter.

SCIENCE-GOSSIP.

List of Exhibits at the Eighth Annual Exhibition, Department of Microscopy of the Brooklyn Institute of Arts and Sciences, Art Association Hall. 174 Montague St., Brooklyn, Monday, January 14, 1895.

Bausch & Lomb.—Micro-Photographs. Descent from the Cross, and Portrait of Dr. Carpenter, F. R. M. S. Arranged diatoms. Head of louse, *Pediculus capitis*. Sea sand, Bermudas. Trachaea-potato bug, *Doryphora decemlineata*.

W. Bowdoin.—Vinegar eels.

Mrs. W. G. Bowdoin.—British diamond beetle, *Phyl. pomona*.

Frederick Kato.—Zinc oxide, an accidental crystallization.

Prof. W. C. Peckham.—Lingual ribbon of poludina.

C. P. Abbey.—Bouquet of butterfly scales, composed of 135 pieces.

Geo. W. Muller.—Polycystina.

Horace W. Calef.—Hairs of sea mouse, *Aphrodite aculeata*. These hairs form tufts of bristles which encircle this marine, spindle-shaped worm, and serve as weapons of defence.

Henry F. Crosby.—Foraminifera, Gulf of Mexico.

A. H. Ehrman.—Elytron (wing case) of diamond beetle, *Entimus regulis*. Pollen of corn cockle, showing anther beards, polarized.

James Walker.—Six rock sections from the drift of Brooklyn, shown with automatic revolving stage and polarized light. Cacoxenite on limonite, from Lancaster Co,, Pa., a hydrous basic phosphate of iron.

Louis W. Froelick—Spines of echinus.

M. H. Wilckens.—Sections of cork.

Dr. Heber N. Hoople.—Ovary of canna, cross section.

Frank Healy.—Crystals of salicin, shown with polarized light.

Dr. J. W. Metcalf.—Citric acid, shown with polarized light.

Chas. E. W. Harvey.—Tingis hyalina, a small insect, with thin wing covers filled with gauze-like meshes.

James Wood, M. D.—Trichina spiralis in muscular fibers of pork.

Dr. N. B. Sizer.—Tongue of a cat, showing gustative papillae.

D. A. Nash.—Transverse section of pine needle. Double stained.

Wm. Finney.—Rhinoceros horn.

Chas. M. Skinner.—Adamite, from Laurium, Greece.

Dr. A. J. Watts.—No. 1 gold crystals. No. 2 gold crystals.

John Lamont.—Section of fibrolite, from New York city, shown by polarized light.

H. S. Woodman.—Eye of beetle, showing the revolution of the second hand of a clock through all the eye-facets which are in focus.

Dr. S. E. Stiles.—Section of jaw and lip of kitten one day old, showing tooth germ, glands, hair bulbs and hairs.

G. E. Ashby.—Cheese mites. Stilton. Fresh water shrimp. Polarized.

Rev. J. L. Zabriskie.—Soldier of one of our common ants, *Pheidole Pennsylvanica Rog.*, showing strong mandibles and enormous head. Collected at Fisher's Island, N. Y., August, 1891.

George M. Hopkins.—Incinerated leaf of deutzia, showing the star-like silicious hairs unchanged.

A. A. Hopkins.—Crystals obtained from black writing ink.

Prof. Wallace Goold Levison.—Natrolite, Snake Hill, N. J.

John W. Freckleton.—Section of chalcedony, by polarized light.

Dr. H. M. Smith.—Stem of rosa canina.

H. B. Baldwin.—Blood spectra. The upper spectrum is that of Oxy-Haemoglobin in normal blood. The lower spectrum is of a Reduced Haematin in blood, chemically treated, and shows the two dark lines a little further to the right.

J. A. Grenzig.—Sections of wood, shown by old microscope made by Jones & Son about the latter part of the Eighteenth century, with accessories, etc. The slides are made of ivory and the sections mounted between plates of mica.

Geo. A. Fiske.—Skin of skate fish.

John H. Royael.—Native copper, from Butte, Montana.

John J. Schoonhaven, A. M.—Foraminifera, from Cuxhaven.

Franklin W. Hooper.—Section of stilbite, from Upper Montclair, N. J. Polarized.

E. B. Meyrowitz.—Stem of pumpkin. Flea.

A. D. Balen.—Pond life.

J McCallum.–Blackberry. Tranverse section of stem of young plant.

F. B. Briggs.—Tranverse and longitudinal section of banana stalk. Polarized light.

Wm. Urban, Jr.—Section of elder tree. Section of quartz, *Pseudomorth*, after Pectolite, from Paterson, N. J.

Henry W. Schimpf.—The worm of the jumping bean, *Carpocapra solitans.*

Brooklyn College of Pharmacy.—Clove (longitudinal section). Oil

glands can be seen along the edge. Snake root (cross section of stem.) Quinidine, an alkaloid obtained from Cinchona. Cinchona, Peruvian bark. Crystals of chlorate of potassium. Crystals of sulphate of morphine. Mandrake root, *Podophyllum peltatum*, cross section. Water lily, transverse section. Fennel, triplet mericarps. Licorice wood, *Glycyrrhiza glabra*, (cross section). Ipecac root (cross section). Lycopodium adulterated with Pine Pollen. Slippery elm bark. Crystals of benzoic acid. Thorn apple, *Datura stramonium* (cross section).

Dr. Jos. H. Hunt.—Thin plates of quartz, shown with polarized light. These plates are natural groups of quartz crystals which are distorted into flat plates by being deposited between the layers of mica.

Sereno N. Ayres.—Three micro-photographs.

G. S. Woolman.—Insect scales, arranged in a bouquet of flowers.

Queen & Co.—Tongue of blow fly. Native wire gold, North Carolina. Crystals of copper.

E. C. Chapman.—Foraminifera opaque.

P. D. Rollhaus.—Seeds of the *Grandiflora imperialis*. [in motion.

F. L. Lathrop.—Aurichalcite, from Colorado, showing a deep cavity

William Krafft.—Sting of honey bee. Section of a lung of a coal miner. Blood from a frog. Proboscis of a butterfly.

H. Endemann, M. D.—A micro-spectroscope.

Officers of the department: Horace W. Calef, President. H. S. Woodman, Vice-President. C. P. Abbey, Treasurer, A. H. Ehrman, Secretary. James Walker, Curator.

Dr. Cutter's Method.—If tuberculosis in its earliest stages can be detected by looking at the blood with a microscope, as Dr. Cutter claims, then our scientists will have another test for tuberculosis which can be used either separately or together with the present tuberculin test. Dr. Cutter's method would be free from some of the objections to the tuberculin test; for only a very small quantity of the blood is needed and nothing is put into the animal's system, so that nobody could claim that the disease is hastened or favored by the test itself. The microscope test, moreover could be made quickly without the labor and delay of taking temperatures and watching results. It is also claimed that the disease can be detected in any stage from first to the latest, and that the extent of its ravages can be decided from the blood, so that mild cases need not be slaughtered as now but might, instead, be quarantined for possible complete recovery. Certainly the claims of this test and position of its advocate warrant investigation. As for Dr. Cutter's general theory, on the causes and cure of the disease, the evidence does not appear at all sufficient. It seems hardly to have been proved that the

substance found in the tuberculous blood is identical with the yeast germ, nor is it clear that the substance, although an accompaniment of tuberculous blood, is really a cause of the disease. As to the effect of ensilage, it is well known that tuberculosis has existed where silos were unkown. However, the theory is enough like the investigations of certain French scientists to be of considerable interest. Under the name of mycodermin, a substance derived from the culture of the yeast plant, has been advocated by eminent scientists of Paris as a cure for tuberculosis and remarkable success has been claimed. It is possible that with the American and French investigation combined we may yet be given a new and better theory, test and cure of this difficult disease. The fact of immediate concern, however, is the alegded new test which lays claim to certain merits not posessed by the test now in use.

RECENT PUBLICATIONS.

Sidney Forrester. By Clement Wilkes. New York. Jan. 1895. No. 1 of Castleton Series. 12° 351 pp. 50 cents.

This is a clean, interesting story of a boy who under the control of a rich, fussy and stingy old grandmother, grew up without religious or distinctly elevating influences but who developed much sense and goodness of character. How he came to be a noble young man in the midst of untoward circumstances is well portrayed, but what were the causes of his virtues do not appear to the casual reader.

The purpose of the book seems to have been to afford the means of whiling away an evening (as we have done) in pleasant relaxation. There are no startling situations, no very improbable incidents, very few love episodes, no plainly moral teachings, no immoral nor questionable recitals, no allusions to religion of any kind direct or indirect.

It is a book for boys of average make-up, not those who crave blood-thirsty recitals, nor who read Sunday School books, but for boys, just boys. Incidentally, it is for all of us who like boys; not bad boys, not boys too good to live, but boys, frank, noble, generous boys, modest boys that are not too modest' peaceable boys, who nevertheless will fight when honor so demands,—in short boys of sense.

THE MICROSCOPE.

APRIL, 1895.

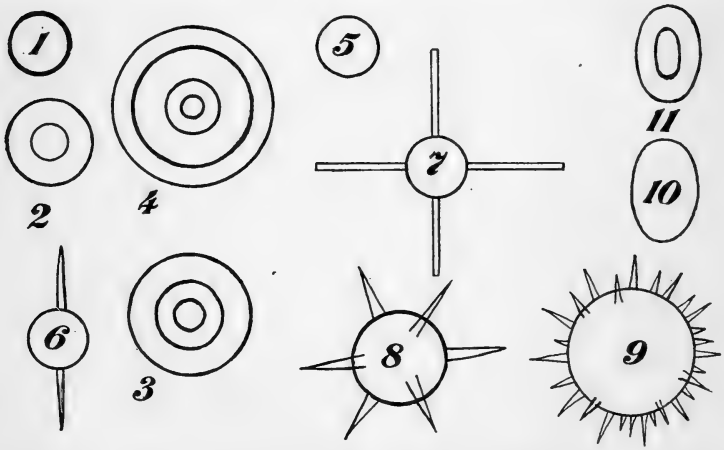
NUMBER 28. NEW SERIES.

Helps toward the Study of the Radiolaria.

By FRED'K B. CARTER,

MONTCLAIR, N. J.

The study of the Radiolaria is somewhat perplexing at first owing to the fact that the subject is so entirely new to most microscopists that they are unacquainted with the terms which are used in describing them. It is quite different in this respect from the study of the Diatoms for



example. When one first attempts that study he is already familiar with many of the terms from having read so much about them. But the man who takes up the Radiolaria has not read much about them. In fact there has not been anything for him to read worth speaking of, not

NOTE—The diagrams are not drawn to scale and give no idea of the size of the forms they represent.

a single book in English at his command that he could turn to for any definite information. Ehrenberg's work is in German, and while the illustrations are most valuable, the text gives no descriptions of genera or species but is confined to notes on the geology of the subject and to references to the different localities. Mrs. Bury's atlas is merely a collection of plates without any text. Hæckel's Monograph on the Radiolaria (1862) is also in German.

It is true his later magnificent work on the Radiolaria is in English but has not been at the command of the student owing to the price, about forty dollars, and few would have known where to find a copy even for occasional consultation. There is a copy in the Astor Library and I believe there is another in the Library of Columbia College, but beyond these two I know of no others in public libraries in and around New York. Unless I am very much mistaken it is not in the Brooklyn Library or even in that of the Philadelphia Academy. Most amateurs have recourse simply to such a work as that of Carpenter on the Microscope and nothing could show more strikingly the dearth of information available on the subject than that work. For the Radiolaria are disposed of in about five pages of text of which only two are given to the classification and they afford almost no help. I am speaking of the sixth edition which is the one in most general use. But the seventh is little better.

Contrast the elaborate treatment of the Foraminifera which takes up fifty pages or of the Diatoms to which forty pages are devoted. In fact it was this dearth of available information, which led me to write the series of articles on the subject which have appeared during the last three years in the Journal. But even when the information is given there is another difficulty, namely the large number of terms necessary in description owing to the astonishing variety of form presented by the Radiolaria. So that even with the key before him the stu-

dent may still be at a loss as to precisely what is meant by this or that character. And so it has seemed to me that it would be helpful to illustrate the key by some diagrammatic figures which would bring before the eye simply the principal characters which occur in the course of the classification. The diagrams are very rude but they will answer the purpose. They are not intended to represent any particular species but merely to give a general idea of the structure in each case.

I shall assume then that the reader knows nothing whatever about the classification of the Radiolaria but is simply acquainted with their general appearance as he has seen them on a slide of Barbadoes earth in balsam. Let us suppose him to have such a slide before him and to be able to identify the forms as far as the genera are concerned. How shall he go to work?

The first thing to do is to find out whether the form which is under observation is spherical (or approximately so) and has no single large opening, or whether it has the shape of an egg, cone, or bee-hive with a large opening at one end. Let us suppose that the former is the case. Now that puts it in the Legion Spumellaria and limits him to that part of the Key. Look again therefore, and see if the shell is a true sphere, or an elongated sphere (prune-shaped), or a flattened sphere (disk-like). We will say it is a true sphere. Then it belongs to the order Sphæroidea. What now about spines radiating from the surface? Is the form free from them like fig. 1? That places it in the Family Liosphærida. Now is the sphere hollow? It belongs to division A. Put on an $\frac{1}{8}$th objective and if the surface is smooth it is Cenosphæra; but if the pores project in the form of little tubes just a trifle beyond the margin it is Ethmosphæra. But perhaps as you focus down on your sphere you find it is not hollow but that there is another sphere inside, like fig. 2. Then it is div. B, Car-

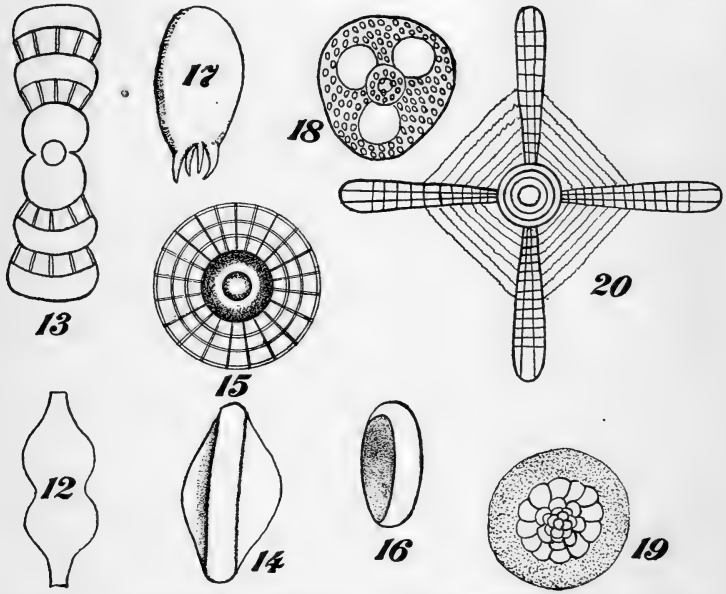
posphæra. Or there may be two spheres inside like fig. 3. Then it is div. C, either Rodosphæra or Thecosphæra, and if the two inner spheres are close to the centre it is the latter. If on the contrary one inner sphere is close to the outer shell it is the former. Possibly you may detect three spheres inside like figure 4, or even four spheres. In the first case it is Cromyosphæra, in the second, Caryosphæra.

But suppose it has spines, what then? Why mark the number and how they are placed. Are there two, opposite, like fig. 6? Fam. Stylosphærida. Four, forming a cross, like fig. 7? Fam. Staurosphærida. Six, opposite in pairs, like fig. 8? Fam. Cubosphærida. Eight to twelve or more like fig. 9? Astrosphærida. Take one more look to see whether the sphere in each case is single or has other spheres inside and the rest of the Key will explain itself, the only genus needing any note being Saturnalis, which looks like fig. 6 with a circle drawn around it so that the tips of the spines would just touch the circumference.

However, your form may not be a true sphere, a section of which would be like fig. 1, but ellipsoidal, a section of which would be like fig. 10. If so it belongs to the Order Prunoidea. Is the margin entire, like fig. 10, or has it a constriction, like fig. 12, forming two chambers, or several constrictions, forming four or more chambers like fig. 13? Then it belongs respectively to div. A, or B, or C, of that part of the Key which treats of ellipsoidal shells. If A, is it hollow like fig. 10, and is the surface latticed or covered with pores? Fam. Ellipsida. And the genus will depend on the absence or presence of spines and the disposition of them. Or has it an inner shell like fig. 11? Druppulida, and the Key will readily give the genus, the only explanation needed being that the medullary shell is the inner as distinguished from the outer which is termed the cortical

shell. Or is your shell spongy, the surface a mass of confused meshes instead of regular pores? Fam. Spongurida. Here again the only note necessary is that a latticed medullary shell is an inner shell with pores. If your shell belongs to div. B, or div. C, you will find no difficulty with the genera.

But instead of being a true sphere or an elongated sphere, your form may be a disk more or less flattened. Focus on it carefully and see which figure it more resem-



bles, No. 14, or 16. That is, if it were tilted would it show such protuberances as those in fig. 14 or lack them like fig. 16? If the form is a phacoid shell, resembles in shape a bi-convex lens with broad edges, it belongs to div. A. of discoidal shells, in which there are two families, the Phacosdiscida and the Coccodiscida. If the margin of the phacoid shell is simple, or only armed with radial spines, it is one of the former, and the number of the spines, and of the inner shells, and the presence or absence of a girdle will give the genus. By this

girdle what is meant is that the shell loses its convexity and becomes flattened at the margin. Imagine a bi-convex lens turned edgewise and a ring of thin glass encircling it in the equatorial plane and you will understand what is meant by the "hyaline equatorial girdle" of Periphæna. If on the contrary the margin of the phacoid shell, when only one surface is presented, is surrounded by concentric chambered girdles or rings it belongs to the Coccodiscida. "Each of these chambered girdles," says Haeckel, is composed of a circular ring in the equatorial plane, a variable number of radial beams dividing it into incomplete chambers, and two porous cover-plates or "sieve-plates," covering the upper and lower face of the disk. These sieve-plates may be regarded as incomplete lenticular cortical shells, which are only developed in the peripheral part of the disk, whilst their central part is represented by the only complete cortical shell, the "phacoid shell." The general appearance is that of fig. 15. Here again the presence or absence of spines or arms or membrane will serve to distinguish the genus. By chambered arms are meant such projections as the four club-shaped portions of fig. 20, and by membrane the fine spongy framework between the arms in the same figure, the technical term for which membrane is "patagium."

If your form is not like fig. 14 but like fig. 16, it belongs to div. B. In this division there is no "phacoid" shell, but a flat discoidal shell. There are two families in this division, the Porodiscida and the Spongodiscida. In the former, instead of a phacoid shell, there is a small simple central chamber surrounded by a number of small latticed chambers of nearly the same size and form (Haeckel). The surface of the disk on the two flat sides is covered by a porous sieve-plate.* In the first section there are neither spines nor arms nor any wide

*Challenger Report.

openings on the margin. Of the two genera, Perichlamydium is characterized by a thin solid equatorial girdle which Porodiscus lacks. In the former also the chambers surrounding the central chamber look more like a mulberry-mass of cells than a series of rings, and the form presents the general appearance of fig. 19. (In this figure the pores over the central and surrounding chambers are not shown). In the next section there are still no chambered arms or radial spines, and the main characteristic in the genus from Barbadoes is a single opening on the margin which is surrounded by spines. The nature of the openings is shown in fig. 18 which, however, represents a genus not found in Barbadoes which has three of these openings and no spines. Fig. 17 gives some idea of the outline of the Barbadoes form and of the opening and spines. In the next section there are no arms and no openings but radial spines, the number of which, together with the presence or absence of a girdle serves to distinguish the genera. And in the last section there are chambered arms, the number and disposition of which, together with the presence or absence and the disposition of a patagium or membrane, form the distinctive marks of the genera.

Finally in the Spongodiscida the sieve-plates disappear, and the shell is more or less spongy in character. The simple spherical central chamber sometimes has concentric rings around it but the surface of the disk shows an irregular spongy framework.

This finishes the Spumellaria. Next we come to the Nassellaria.

To be continued.

Focusing Upward.

By R. H. WARD, M. D.,
TROY, N. Y.

It is often advised to focus downward towards the slide, using great care not to go too far, until the object is actually seen. More prudent advice would be to set the tube too low for its focal distance, in every case, while observing it from the side by looking through, horizontally towards the light, between the objective and the slide, and then find the object by focusing upward while looking down the tube. After this, the whole thickness of the object can safely be examined by focusing slowly, and in many cases almost constantly, through it, forward and backward.

Some experts of great experience, prudence and self-control, persons of microscopic touch, and to whom caution and accuracy have become instinctive, may find the focus in almost any way, scarcely knowing or caring how. One of the commonest of these expedients is, while working the rock with one hand, to feel the way with a finger of the other hand, touching lightly the side of the objective at its lower edge, while the same finger or the next one, according to circumstances, projects downward to touch lightly the top of the slide. This gives a positive, and for low and medium powers, a sufficiently accurate knowledge of the varying distance from the objective to to the slide. But some of those heedless persons who, with the best of intentions, are always doing something wrong, until their suffering friends are strongly tempted to wish they were enemies instead, will either push the slide off from the stage to be broken by the fall, or else misjudge the indications of their touch until they hear the glass cracking under the pressure of the objective, when they will exclaim, more truly than they mean, "Oh! I didn't think——."

To nearly all beginners, and to an uncertain proportion

of others, the looking for an object while focusing down toward it is far from safe; at least, that is the result of the writer's observation during thirty-eight years of continuous and earnest attention to microscopy. But an inch objective is used far away from the slide, and at a perfectly safe distance? So is a three-inch, several times as far away; yet the writer has seen a highly cultivated man and experienced microscopist, in the midst of his best years, drive a 3-inch objective, with a crash that was heard throughout the room, through a unique and priceless slide—belonging to somebody else. But he was a stupid blunderer? Well, that is what *he* said, with manifest disgust and contempt, and he ought to know; in fact he abjectly announced his resolution to devote the blighted remainder of his worthless life to the fitting penance of eating all the "humble pie" that the spectators would condescend to prepare for his sanctification. But this is the world we are living in at present, and such acts of farce-tragedy are common enough to recur to anybody; as evidently they did to Dr. S. when he wrote of a tin cell that was too thick to be pleasing. "However, the cell serves one good purpose; the diatoms cannot be crushed between cover glass and slip unless a very strong hand is wielding the coarse adjustment."

The only safe rule that can be followed without being sorry sooner or later, is, *never* to find the object by focusing downward, and, *never* to allow anyone else to do it with your apparatus or objects. If one must focus downward, which seems temptingly easy, but in the end is the most difficult and tedious way he should do it with his own things; so as to make sure of the benefit of the scolding which politeness will hardly prevent his giving to himself when the first (and last?) accident happens.

This method of finding the object is applicable to even moderately high powers, of moderate angular apertures; using the foreign particles too freely present on the top

or bottom of the cover-glass, or top of the slide, or in the mounting medium, or the imperfections of the glass surfaces themselves, or in the cut edge of the cover, as a clue for locating approximately the plane of the object—which may be unexpectedly difficult with very minute transparent objects, such as a very few small diatoms or slightly stained bacteria or, still worse, very fine micrometer rulings.

With extreme apertures, or where the objective, suitably corrected, may nearly or actually touch the cover, the greatest skill is requtred, and some danger exists even in the best hands. Even then the lens can usually be set as described above, so near that a glimpse, probably vague and distant, can be gained of almost anything coarser than the fine rulings or bacteria; when an upward touch of the ffne adjustment will either reveal the object distinctly or show that it is farther below. In the later case, while the fine adjustment is being lowered with extreme care, the slide may be frequently slipped upon the stage by the hand, over a distance which is a very small fraction ol the field of view (with a tolerably steady hand there is no difficulty in moving it as little as 1-20 mm., or 1-500 inch), in order to detect, by the increased resistance, any pressure of the objective before it becomes destructive. Or, if the hand be steady, the near side of the slide may be held gently down against the stage, and, the spring clips if any, being turned aside, the far edge of the slide be lifted by one of the finger nails until the now slanting cover-glass touches one edge of the mounting of the objective. This can be done with ease when the distance is less than the thickness of a sheet of paper; it furnishes deffinite idea as to the distance, and gives ample warning as that distance decreases and disappears. As the available focal distance varies with the screw-collar adjustment, it is well, with suspiciously thick covers, to adjust for maximum distance for finding the object, and

then reduce the adjustment until best definition be secured or be proven to be impracticable; as the lens when set for a minimum depth might rest upon the cover, while the object was still out of sight directly below the field of view. It is folly for any but the experts to attempt such work, and they will generally be wise enough to prefer doing it over their own slides.—*P. M. Club.*

What are the Bacillariaceæ.

By ARTHUR M. EDWARDS, M. D.

NEWARK, N. J.

As I have proposed to change the name Diatomaceæ to Bacillariaceæ I will say why that change should be made. The name is not a new one. To explain why it is proposed to renew it, I quote from the Rev. Eugene O' Meara in his Recent Researches on the Diatomaceæ (Vol. XII, n. s. of the Quarterly Journal of Microscopical Science, 1872, page 240, reprinted from the Journal of Botany, March and May, 1872.) Therein he says: "The name Diatomaceæ has been used by nearly all of the recent authors to designate this group. Rabenhorst, in his more recent work, has adopted the name Diatomophycæ, but in his former treatise used that of Diatomaceæ, "die Susswasser Diatomaceen;" and in this he has been followed by Gmelin, Heiberg, Shumann, Cleve and Suringar. Dr. Pfitzer, however, mentions that the name Bacillariacæ should be substituted, the genus Bacillaria having been established by De Candolle in 1805; and some of the older writers on the subjects have used this designation. It may be deemed inconvenient now to abandon the name of the group which has been so generally adopted, but on technical grounds, Dr. Pfitzer's view is undoubtly correct."

So it happens that the organisms which were called Diatomaceæ are now and should be called Bacillariaceæ. Popular observers who are not students may still call

them Diatoms, which is the English of the scientific Latin Diatomaceæ. So they may call Bacillariaceæ Bacills. But Diatoms are the siliceous shells, or loricæ of the perfect organism. The organism itself is a mass of protoplasm which secretes within itself the Diatom, just as shells are the loricæ of Mollusca and bones of man, so that when observing Diatoms we are not studying Bacillariaceæ. To study them requires time and patience. We can observe Diatoms and mount them to show them but that is very different from studying them. To study them, the observer must be a microscopist of no mean character and know biology, the science of plants and animals. He should be a physicist besides, and this requires time and patience. An observer may see the diatoms when looking at about one hundred slides but the student of the Bacillariaceæ has to spend many hours of patient toil to work out even the outline of one Coscinodiscus. Pleurosigma angulata requires many observations on specimens from various localities.

The Bacillariaceæ are not animals nor vegetables but possess characters that have induced Hæckel and other observers to rank them along with other organisms temporarily in a kingdom by themselves, in the Protista. But kingdoms are only transitional and they but items of the lowest organisms. Low because they carry on their life in a simple manner. And because they are so simple they are not affected by what we call evolution. Those that first existed in the Laurentian are the same as grow now. Epithemia turgida of the Silurian age is Epithemia turgida of the recent.

Students must not forget that Bacillariaceæ is but a name for organisms which are seemingly simple in character and bye-and-bye we may have to record complex things that they do and mighty work that they accomplish. They are simple when viewed by present knowledge, but they are mighty when viewed by the results.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Lighton's Stained Diatoms.—It was with much regret that we received lately a letter from a subscriber who complained that the slides he had purchased from Prof. Lighton were "not fit to be placed in any cabinet." He indignantly demanded from Prof. Lighton the return of his money and reported the matter to us. We have made some investigation and have letters of four other purchasers before us, from which we conclude as follows:

Prof. Lighton's material was not perfectly cleaned and as a consequence a certain amount of rubbish has been mounted with the diatoms. But that he has succeeded in staining the diatom shells in a satisfactory manner is well established. This is, however, not a new discovery. Dr. Edwards stained them many years ago. Lighton uses the aniline dyes. Edwards confirms this method, and says he tried haematoxylin and Prussian blue unsuccessfully.

No other fault has been found with Lighton's mounting and the reason why the purchaser would not put the slides in his cabinet was, as he said, that his cabinet was not a place for "stained dirt." Prof. Lighton claims to have returned his money to him by registered mail and we have not heard to the contrary. He ought next for neatness sake to learn how to clean diatom material, and to avoid occasion for controversy. The complainant, however, has been too severe and attempted to

create unnecessary alarm. Curiously he is the Judge of a court. We should hate to be tried before him.

We think the above explanation does exact justice to both parties and can be relied upon by others who have any idea of getting stained diatoms. Should further developments put any different aspect upon the matter we shall regard the public interests as paramount to those of Lighton, the purchaser or even of ourselves. We shall discontinue the advertisement the moment any dishonest proceedings develop. Our favor will not be bought with money, advertising or other considerations. We have fallen upon evil times and deceptions abound. We lost a subscriber last year by telling the truth about his book. We can spare one or two more on the same terms, if need be.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,

CLEVELAND, OHIO.

Making Sections of Coal.—In the February number of the Microscope an article under the above title was published. The recipe or process though taken from a standard authority seems to be open to objection. The process there published is said to be applicable to lignite only. For coal, I abstract the following process from Acadian Geology, by Dawson, p. 493 *et seq.*

The vegetable nature of coal may be seen by closely inspecting the surfaces of a lump of the mineral with the aid of a bright light and a magnifying glass. For the microscope, results have been obtained, more particularly, with mineral charcoal. Select specimens containing the tissues of a single plant.

Fragments or portions of stems of this character can be obtained by careful manipulation from most coal. Place the pieces to be examined in marked test tubes, treat them with strong nitric acid, heat to the boiling point and keep in that condition so long as dense fumes of nitrous acid are disengaged, or until looking through the tube, the material can be seen to have a brown color and a certain degree of transparency. In many cases, boiling in this manner for a short time is sufficient to render the fibers flexible and as transparent as slices of recent wood when slightly charred.

When ready for examination, the charcoal should be allowed to settle, and repeatedly washed with pure water before removing it from the tube. It should then be examined in water, with powers of from 50 to 500 diamaters and may then be dried and mounted in balsam. Some refractory specimens require alternate washing and boiling in nitric and hydrochloric acids before their structures can be made out. The process here indicated does not produce a siliceous skeleton of the coal, but removes the bituminous matter which is oxidized and dissolved by the acid, and the mineral matters especially the sulphuret of iron, which is one of the principal causes of the brittleness and opacity of the crude mineral charcoal.

Mineral charcoal is also known as fibrous coal, fossil coal, mother-of-coal and is a soft black substance resembling charcoal in appearance found in connection with coal, usually along its planes of stratification or lamination in which the woody character of the material from which the coal was formed is more perfectly preserved than it is in the body of the coal itself.

In Dana's Manual of Geology it is said that even solid anthracite has been made to divulge its vegetable tissues.

Another method of examining coal is to grind the coal to a fine powder and examine the fragments. Only the finest powder will show structure. This plan is unsatisfactory.

Another method is to burn the coal to a white ash and examine it under the microscope. This ash often exhibits perfect skeletons of vegetable cells, but these are fragile and require great care in their management. They should be first soaked in turpentine and then mounted in Canada balsam.

Section of Water Lily.—A section of the stem of the water lily (Nuphar Advena) double stained, will make one of the pet slides of a cabinet.

The section cut near the joint or across the petioles makes the prettiest mounts, as they are composed of different kinds of cells, the usual parenchyma and of stellate cells, each of which will take a different stain. When well cut and properly stained they will make a slide of which any microscopist may be proud.

Beal's Carmine Staining Fluid.—The following formula will be useful:

Carmine.....10 grains.

Strong liquor Ammonia	½ drachm.
Glycerine	2 ounces.
Distilled water	2 ounces.
Alcohol	½ ounce.

Cell Culture of Fungi.—Most kind of fungi especially the blue mold found on bread and on top of preserves may be cultivated in cells and conveniently examined in these cells with the microscope. The following is copied from Bessye's Botany, page 240.

The most accurate and satisfactory, but at the same time most difficult cultures, are cell cultures. They are made as follows:—glass. tin, or India rubber rings four to five millimetres high are fastened to ordinary glass slides; a very little water is placed in the bottom of the cell so formed, to keep the air in it always moist; a small drop of the nutrient liquid, free from spores of any kind, is placed in the middle of a cover glass of the proper dimension, and in this a single spore of some particular mould is placed; the cover glass is now inverted over the cell. The preparation must be placed in a warm and saturated atmosphere. An ordinary bell-jar set over a plate of water, or better still, of wet sand will furnish a very good moist chamber.

Nutrient fluids are as follows:— First, boiled and filtered orange-juice; second, a decoction of horse-droppings boiled and filtered; third, a saline solution as follows:—

Calcium, nitrate	4 parts.
Potassium phosphate.	1 part.
Magnesium sulphate	1 part.
Potassium nitrate.	1 part.
Distilled water.	700 parts.
Sugar	7 parts.

In some cases the sugar may be omitted.

SPECIAL NOTICE.

Radiolaria material.—Those who are sufficiently interested in Rev. F. B. Carter's article on pages 49–55, to wish to study the subject can obtain some material by addressing him at Montclair, N. J., and enclosing stamps.

THE MICROSCOPE.

MAY, 1895.

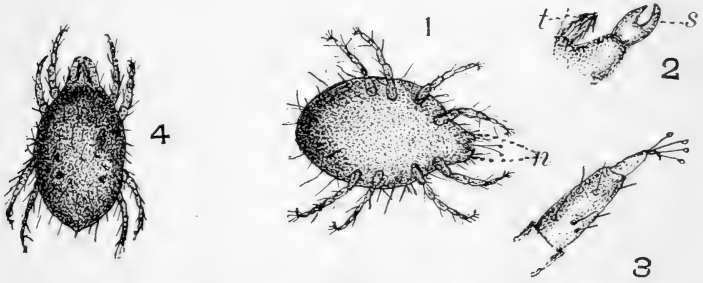
NUMBER 29. NEW SERIES.

Objects Seen Under the Microscope.

BY CHRYSANTHEMUM.

XXIII.—RED SPIDER (GAMASUS TELARINA).

This little spider is found on rose-bushes and is so small as to be seen with difficulty without the aid of a glass. Its presence is detected by the sickly, yellowish and mottled appearance of the leaves. If the under side of one of these leaves be examined a minute silken web will be found.



Examine carefully any little red or yellow spot on or near this and by touching it with a dissecting needle perhaps one of the spiders may be seen running about. Try and induce it to run upon a slide or cover-glass. This is a difficult thing to do as its feet are not made to walk on smooth surfaces, but with a little patience and the aid of a dissecting needle it can be accomplished. To kill them, proceed as with the Aphis, (see Mar. No.) but more alcohol is required, or coal oil may be used. This requires some time to evaporate. Great care must

be taken for they are so delicate that their parts are easily displaced. It may be well to look at one while it is still alive. If an adult, it has an oval body, Fig. 1, four pairs of legs and two mandibles, (Fig. 1 n.), but it has no eyes. It is not a true spider, neither a true insect, but belongs to the same family as the mites (Acarina). Its body and legs are furnished with hairs which are long and very sensitive, those on the feet having a nub at their extremities, making them look like little pins stuck into the feet, Fig. 3. On the under side of the body near the end of the abdomen is the rounded protuberance from which the silk is produced. By the aid of the claws and the hairs on the legs this silk is spun into so minute threads that it takes a high power to distinguish one thread from another. By the united effort of many spiders, tents are formed of this silk and suspended from the hairs on the surface of the leaf. These insects thrive best when it is hot and dry. They use the tents as protection from cold and dampness, and also as a place to deposit their eggs. Although so tiny, they lay a spherical, colorless, transparent egg, which produces larvæ like the parent, except that it is smaller and has but six legs. The larvæ are usually white, while the color of the adult varies from deep red to yellow, green or mottled according to the color of its food. They feed on the juices of plants, piercing the leaves with their jaws, (Fig. 2 s) and extracting the juices with their barbed suckers (Fig. 2 t). Fig. 4 is a dorsal view of a red spider found on the cotton plant. It is also found on the Canna.

To destroy them wash the under side of the leaf with a mixture of 100 parts water, 6 parts soft soap and 6 parts quassia, steeped in water, or coal oil may be substituted for the quassia. If the plant be taken into a cool room for a few days the insects will die.

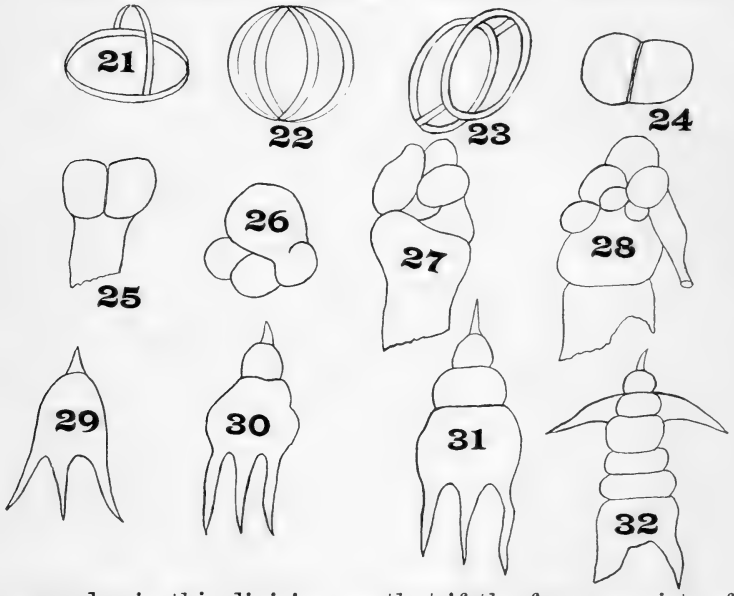
Helps toward the Study of the Radiolaria.

By FRED'K B. CARTER,

MONTCLAIR, N. J.

(*Continued from page 55.*)

In the Nassellaria or Monopylæa, the fundamental form of the central capsule is egg-shaped instead of spherical, and the pores, instead of being distributed all over it, are confined to one area, and the skeleton has the shape of an egg, cone, or bee-hive, with one large mouth or opening. Here are two main divisions. In the first the lattice shell is not complete. There is only



one order in this division, so that if the form consists of a ring or of several rings (see Figs. 21-23) it belongs to the order Stephoidea which means, like a crown or wreath. In the Fam. Stephanida there is only one ring and the genera are thus distinguished:—Zygocircus has simple spines, while in Dendrocircus the spines are branched, giving the appearance of foliage: Cortina and

Stephanium are marked by basal feet or long, thick spines, the former having three, the latter four. In the Fam. Semantida there are two rings (see Fig. 21), one horizontal, the other joined to it in a vertical position. Cortiniscus and Stephaniscus have feet on the horizontal ring, the former three, the latter four. The other genera lack such feet and are separated by the number of pores inside the horizontal ring. The student might suppose that in such cases the forms had no single large opening and were therefore not Nassellaria, but the space inside the basal ring is regarded as such, as it is found entirely open in other genera, and the mouth is assumed to be partially closed by a lattice plate. In another order, that of the Cyrtoidea, we shall find the pores in this mouth plate so small that at first it will be hard for the student to distinguish the forms from those of the Spumellaria by any such mark as that of a single wide opening. The general shape of the form, however, will show him that such forms do not belong to the Spumellaria, the end which is said to have a mouth closed by a lattice plate being different from the other end. In the Fam. Coronida there are also two rings, but they are both vertical meridional rings, intersecting like two hoops crossed at right angles (see Fig. 22) and there is usually a horizontal ring as well. The genera are distinguished by the number of gates or large openings formed by the intersections of the rings. In Podocoronis only two of the gates are basal, in Tristephanium four, the others, in each case, being lateral, that is openings made by the intersection of the vertical rings. In the Fam. Tympanida there are two parallel horizontal rings (see Fig. 23) and these are connected by a vertical ring and sometimes by two vertical rings or more. The joinings of these horizontal rings are also called columellæ or little columns. Microcubus has four of these

columns, that is the horizontal rings are connected by two vertical rings. Tympaniscus has six columns or three vertical rings, and Tympanidium eight columns or four vertical rings. The student should understand that these vertical rings are incomplete, and that the little columns are supposed to represent segments of such rings, in other words that if vertical columns (as in Fig. 23) were produced and united above and below where they join the horizontal rings they would form a complete vertical ring.

In the second division of the Nassellaria the forms have a complete shell, and the shell is latticed, that is has pores. Here are three orders which are distinguished by the form of the cephalis or first joint. In the first order, the Spyroidea, this cephalis is bilocular, that is, it is divided into two chambers by a middle partition,(see Figs. 24, 25). The Fam. Zygospyrida consists of those forms which have only a cephalis (see Fig. 24), in other words there is no second joint or thorax as it is called. The genera are divided into sections by the number of basal feet, the last section lacking them altogether, and are still further separated by the number and disposition of horns or the absence of them. In the Fam. Phormospyrida, besides the cephalis there is also a thorax, that is, the shell consists of two joints (see Fig. 25) the cephalis being the upper, the thorax the lower. And in the Fam. Androspyrida the cephalis has an apical cupola, or little dome at the top.

In the second order, the Botryodea, the cephalis is multilocular, that is consists of several chambers, and their appearance is that of lobes, (see Figs. 26 28). The forms of the Fam. Cannobotryida have only the cephalis, (see Fig. 26), while those of the Fam. Lithobotryida have a thorax, or second joint also, (see Fig. 27). Here we meet with the distinction, mouth closed, which I

spoke of a page or two back. The genera Lithobotrys and Botryocella instead of lacking a mouth, as would appear at first sight, are said to have the mouth closed. It will puzzle the beginner to find any trace of a mouth in the shell, and he must accept the fact on the authority of Haeckel who gives us this distinction. At the same time he will readily recognize the general resemblance of these forms to all the rest of the Botryodea by the presence of the peculiar lobes, and as many of them have a mouth it will only require a slight stretch of the imagination to believe that in these forms the mouth has been closed by an abnormal growth of the lower part of the shell. At any rate they do not at all resemble the Spumellaria in shape, and if we had the living forms before us, we should undoubtedly find that the openings in the capsule (the inner portion of the protoplasmic body of the animal), were confined to the area facing what is called the closed mouth. In the last Fam. of this order, the Pylobotryida, the forms have three joints, cephalis, thorax, and abdomen (see Fig. 28), the abdomen being simply the lowest joint of the three.

In the last order, the Cyrtoidea, the cephalis is simple, that is, it consists of only one chamber, (see Fig. 29). It has no internal partitions, dividing it into two chambers, as in the Spyroidea, or into many lobate chambers, as in the Botryodea, and the general shape of most of the forms is that of a cone. This is an immense order, comprising no less than 79 genera. But it is divided into four sections, which are very clearly distinguished by the number of the joints in the shell, thus :—

Section A, one joint—Cephalis only ; Fig. 29.

Section B, two joints—Cephalis and thorax ; Fig. 30.

Section C, three joints—Cephalis, thorax and abdomen; Fig. 31.

Section D, four to seven or more joints in the shell; Fig. 32.

By bearing these distinctions carefully in mind the student will be able very quickly to assign any of these forms to the proper section, and then the determination of the family and genus will occasion very little difficulty.

Thus in each of the sections, we have three families which are separated by the presence or absence of what are called radial apophyses (or outgrowths) that is, ribs, wings, spines, or feet. And these three families occur in the same order in each section, so that we meet with these characteristics over and over again, namely, three radial apophyses. Take for example, section A, in which the forms have the cephalis only. The Fam. Tripocalpida has three radial apophyses, which in this family are feet, and the presence of lateral ribs or ridges distinguishes the genus Tripocalpis from Tripilidium. The Fam. Phænocalphida has numerous radial apophyses, which in this family also are feet, and the genera are distinguished by having the mouth open or closed and by the presence or absence of radial ribs or ridges and a horn. The genus Phænocalpis may also be recognized by the presence of a slender column in the axis of the shell cavity. And the Fam. Crytocalpida has no radial apophyses. The key to the genera here is so plain as to call for no comment.

Now these main distinctions run through all the sections. Thus in section B, in which the forms have two joints, both cephalis and thorax, the first Fam. Tripocyrtida starts off as before with three radial apophyses, which in this family are either ribs or wings or feet. In the first division the mouth of the thorax is open. Where the ribs are said to be enclosed in the wall of the thorax, what is meant is that they do not simply appear on the outside of the thorax but are built into it. By a latticed thorax is meant one with pores. The peris-

tome is the circle formed by the mouth of the shell. Where the feet or spines are said to be solid, what is meant is that they have no pores. Wings are only broadened spines and in several of the genera they are so slightly broadened that they are just stout spines and nothing more. But standing out as they do from the sides of the shell, they are called wings because of their position. In the Fam. Anthocyrtida again, there are numerous radial apophyses as was the case with the second family of section A. The only thing in the key to this family that needs to be explained is that when the meshes are said to be simple, the meaning is that the spaces between the meshes are open. Fenestrated meshes are those in which the spaces are partially filled by a fine net-work. And in the Fam. Sethocyrtida we have no radial apophyses, as was the case with the third family of section A.

Again, in section C, in which the forms have three joints, cephalis, thorax and abdomen, we have exactly the same order for the families, Podocyrtida having three radial apophyses, Phormocyrtida numerous radial apophyses, and Theocyrtida none. The abdomen is the third or lowest joint. Remembering that horns are spines on the top of the shell, (see Figs. 29-32) wings, spines on the sides (see Fig. 32) and feet, spines on the bottom (see Figs. 29-31), the key to the genera will be readily understood, the only other point needing explanation being that simple feet are those which as in Figs. 29-31 are not forked or branched. When the feet are divided or forked they are said to be ramified. What the student needs to note carefully in these families is whether the wings or ribs are on the thorax, or partly on the thorax and partly on the abdomen or only on the abdomen. Horns of course will only be at the top of the shell and feet at the bottom.

Finally, in section D, there are from four to seven or more joints in the shell, (see Fig. 32). The first joint is still known as the cephalis, the second as the thorax, the others as abdominal joints, first, second, third, etc., the first abdominal joint being the one next the thorax. By a vertical basal spine is meant a spine on the last of the abdominal joints (which in such forms is closed), pointing in the opposite direction from that which a horn on the cephalis would take.

In conclusion let me say that the student should make some type slides for himself, if he wishes to get an idea of the classification. There are too many forms on a strewn slide for comfort. A type slide of 20 or 40 different forms will be the most convenient for study. The mechanical finger furnished by Bausch and Lomb is very handy for this purpose, but in place of the hair which is supplied with it I use a fine glass hair made from a small glass rod which has been heated in the middle over an alcohol lamp or a Bunsen burner. Just as it begins to melt, the two ends are drawn apart rapidly as far as the arms can reach, and the result is a long, fine thread which floats in the air. Let it settle on the table and cut off a bit of the thinest portion about half an inch in length. Then make a wedge of beeswax, rounded on one side, flat on the other, and press the hair on the flat side so that it projects beyond the wedge point about an eighth of an inch. Press the wedge on the steel rod of the mechanical finger and adjust the finger on the microscope and you are ready for work. In place of a glass hair, I have used a hair of sealing wax with much better results as the forms do not spring off from it as they do from glass.

The student will do well also to procure a copy of Ehrenberg's work, the title of which is "Fortsetzung der mikrogeologischen Studien, etc." Von Christian Gott-

fried Ehrenberg, mit * * * Tafeln, Berlin, 1875.

It must be imported, but can be obtained through Messrs. B. Westerman & Co., 812 Broadway, N. Y. The cost will be from five to eight dollars.

The Character of Agar–agar, and The Bacillariaceæ Found in Connection with it.

By ARTHUR M. EDWARDS, M. D.

NEWARK, N. J.

Agar-agar or Bengal Isinglass is a vegetable product obtained in China from sea weeds: *Eudæmna spinosum*, *sphærococcus*, *licheneides*, *spinosus*, and *tenax*. These Algæ are bleached by the sun and put up in packages. They are almost colorless and look like and are vegetable gelatine. It is used as a medium for the cultivation of Bacteria and is purer than animal gelatine. It dissolves more easily in water also. It comes into commerce in transparent colorless strips, almost completely soluble in water and makes a large quantity of thick, tasteless, and colorless jelly. As dilute sulphuric acid dissolves it, forming galactose, which is characterised by its conversion into galactonic acid by oxide of silver, it is readily cleaned. Nitric acid dissolves it also. The siliceous Bacillariaceæ are then seen very plainly. It does not require boiling in other acids or Bichromate of Potassa but Hydrochloric acid and Bichromate of Potassa are desirable to thoroughly clean it. Washing with water and weak ammonia afterwards when we have the siliceous shells of Arachnoidiscus ehrenbergii clear and briliant. In this way we can get this Bacillarian from the China sea readily. I have also made use of this process on Agar-agar sent to me by Mr. Priest from Japan. It is called birds' nests in China because the sea birds use it in making their nests and it is used

by the Chinese in making a soup. Many years ago microscopists got the Arachnoidiscus from it. The Algæ are brought by the cura siwa or Japanese current to the west coast of North America and there the Bacillariaceæ are abundant. Aranchnoidiscus ehrenbergii is common in the mouth of the Columbia river in Washington and I have it from there sent to me by Miss A. L. Pollock. It is also common in the harbor of San Francisco where I gatherd it myself in 1877, and on the coast until we come to San Diego where it is common.

And this brings me to the statement that Arachnoidiscus ehrenbergii J. W. B. is the only form or species of the genus, the others seeming different but not being realy so.

There are eleven forms or species of Arachnoidiscus, some from recent gatherings and some from fossil, some from California, New Zealand, Barbadoes and Spain but all the same.

It was called by Ehrenberg, Hemiptycus but this name was used for a genus of insects and so Arachnodiscus was adopted. It is named from its looking like a spider's web. There are also present in the Agar-agar specimens of Grammatophora marina FTK and Cocconeis scutellum C. G. E. and Cocconeis pseudomarginata A. G. which I am disposed to think is a variety of C. scutellum. At all events the Bacillariaceæ are scarce in the agar-agar. Spicules of sponge are also found.

Vaselin in Microscopy.—Gawalowski proposes to replace cedar oil and other liquids used for oil immersion for objectives by vaselin, whose refractive index is 1.40.—*Rundschau.*

Fine Mounts of Caterpillars.—Mr. C. P. Bates, 853 Main street, Petaluma, Sonoma County, California, prepares fine mounts of Caterpillars. We advise those who are intereste d in the subject to correspond with him.

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CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Remember the A.M.S. meeting at Ithaca Aug. 21, 22, 23.

Postal Club Vacancies.— We understand in reply to a question about new members, that the managers like to have the names of just a few (very few) to fill vacancies, but that they only need such as will become permanent members. Those who join from curiosity and soon drop out cause serious trouble by breaking up circuits and disaranging arrangements. A club must be a matter of mutual helpfulness and none should apply unless they can contribute in reasonable proportion to what others contribute and especially avoid making trouble by delay, indifference, etc.

Frank P. Peck, M. D.—He was pathologist of the State Insane Hospital at Mount Pleasant, Iowa, where he died June 26, 1894. While the duties of his professional position where chiefly microscopical, they naturally limited his work mostly to medical microscopy, especially in relation to nervous diseases; but he maintained an appreciative interest in the work of others in different fields. Having a genial character, as well as great literary and scientific ability, he was an esteemed and successful leader whose support and influence were always used freely in the interest of the Postal Club.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

223. *Where can I get Tuckerman's Lichens?*

Part I is out of print and cannot be got. Part II costs $2.50, postage 5 cents. We can place your order.

224. *Will you inform me if the silvered prism arrangement described in The Microscope, for Nov. 1888, has given good satisfaction? Where can one be obtained? F. C. Grugan.*

We have no information regarding the performance of the silvered prism described by Dr. Egbert. It seems to have been devised under the impression that a camera box must be placed in a horizontal position when in use. A camera can be easily supported and used in a vertical position, in cases where the microscope body cannot be inclined. The silvered prism seems to have been an unnecessary appliance and was not extensively used. Mr. Zentmayer of Philadelphia could make one.

PRACTICAL SUGGESTIONS.

BY L. A. WILLSON,
CLEVELAND, OHIO.

A Cheap Substitute for Selenite.—The following, which first appeared in the American Journal of Pharmacy, will be of much interest:

Ordinary mica (the kind used in stove doors) furnishes a very efficient substitute for selenite. Select the clearest pieces, cut them to the desired shape, and slip them under the slide to be polarized. Of course the analyzer and polarizer must be in place. If the first view be not satisfactory give the mica a slight turn upon its axis and see whether in any position a satisfactory color is obtained.

When found, cut one end square so that it will be parallel

with the slide; by always slipping the mica in the same way, the same color will be obtained, as the color varies with the thickness. Quite a variety of beautiful color effects will be secured by either using mica plates of varying thickness or by merely using two or more layers of thin plates superimposed.

The colors will be varied still more by altering the relative position of these plates. Three plates of varying thickness will be all that are necessary to keep. If the first piece of mica selected does not suit throw it away and try another.

In Dallinger's Carpenter (seventh edition,) page 271 it is said: The variety of tints given by a selenite film under polarized light is so greatly increased by the interposition of a rotating film of mica that two selenites, *red* and *blue*, with a mica film are found to give the entire series of colors obtainable from any number of selenite films, either separately or in combination with each other.

Scales of Lepidoptera.--These may be exhibited in their natural arrangement by mounting a small piece of wing dry. If desired as test objects, a slide or thin cover, after having been breathed upon, may be slightly pressed on the wing or body of the insect.

Some scales as the poduræ, show a beaded appearance under high powers from corrugation. With a good wide-angled objective, these appearances may be resolved into exclamation points.

Stings and Ovipositors.—These objects present a great variety of structure and are best mounted in balsam. To obtain them, press upon the back of the insect until the organ is extended and while extended, sever close to the body with a sharp dissecting knife. They should then be transferred to oil of cloves for a short time, then to turpentine, and finally mounted in balsam.

Before mounting, it is best to examine them under a dissecting microscope and if not properly spread out, to spread them out well with needles.

Fixing Arranged Objects to a Slide.—A thin solution of clear glue dissolved in alcohol and spread upon a slide, is useful for this purpose. As each object is placed upon the slide,

breathe gently upon it and this will fix it permanently so that it may be mounted in balsam.

SCIENCE-GOSSIP.

Hydrophobia Treatment.—From 1890 to 1895 the Chicago Pasteur Institute treated 366 cases and lost but two by death, while 372 others who applied for aid were dismissed after it had been ascertained that they had been bitten by animals not rabid. Prior to Pasteur's discovery 88 per cent of persons bitten on the head died, 67 per cent of those bitten on the hands died, and 25 per cent of all others. About 60 per cent of those treated were residents of Illinois. Further information may be obtained by addressing Dr. A. Lagorio at the Institute.

RECENT PUBLICATIONS.

The Gospel of Buddah. By Dr. Paul Carus. Open Court Pub. Co., price $1.00.

Every one who has been brought up in the Christian religion and taught that it is the one only true religion; and who desires, instead of being narrow and conceited, to be broad and wise and generous would do well to read the Gospel of Buddah as many times, as reverently, and with the same motives with which he has read the Gospel of Matthew. Were there in this country one hundred thousand clergymen employed for ten generations and paid for sounding the praises of the Gospel of Buddah perhaps it would have a great deal more power upon the people than the Gospel of Matthew now has or ever has had. It is perhaps too much to hope that this book will receive the attention which it deserves.

Whist Made Easier. By Geo. P. Rishel, Hornellsville, N. Y. 23 pp. 35 cents.

One of the best recreations is a game of whist. No book extant gives the rules so compactly and intelligently as this. There is as much discipline in whist scientifically played as in the study of Greek.

THE MICROSCOPICAL JOURNAL.

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FOR SALE.—Crouch Intermediate binocular, circular glass stage, mechanical centering on substage, four eye pieces, achromatic condenser polarizing attachment, stops for dark ground and oblique illumination, parabaloid, two solid eye pieces made by Spencer. All in perfect order and have been used very little. $100. GEO. A. BATES, Auburndale, Mass.

THE MICROSCOPE.

JUNE, 1895.

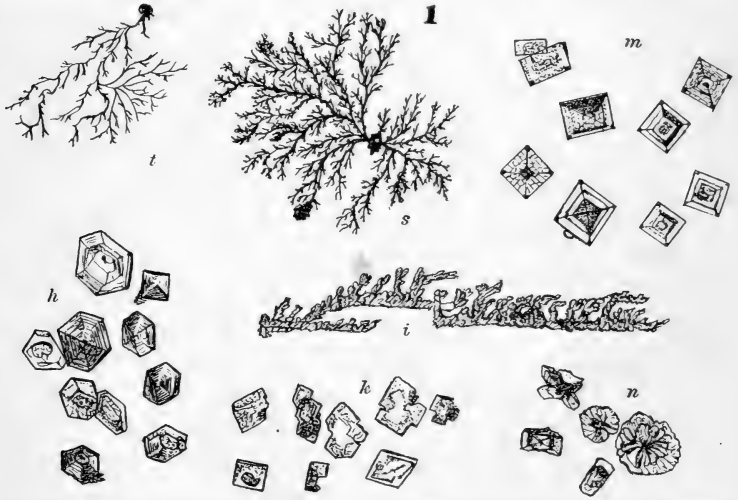
NUMBER 30. NEW SERIES.

Objects Seen Under the Microscope.

By CHRYSANTHEMUM.

XXIV.—CRYSTALS.

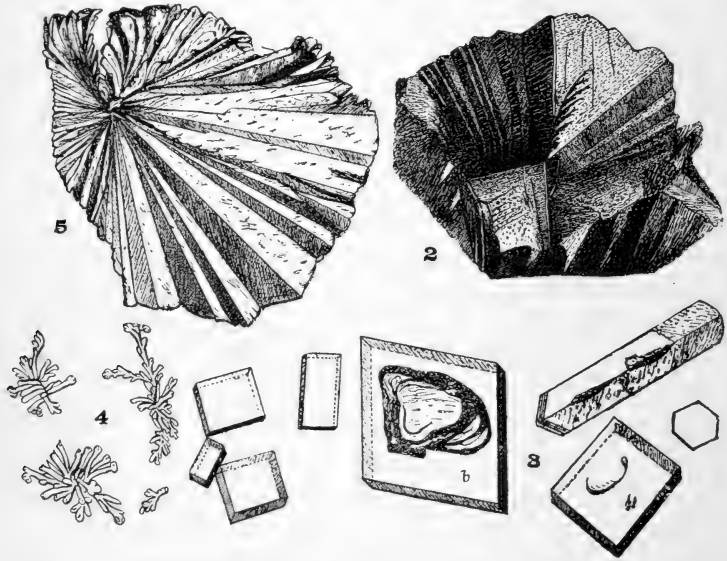
The crystals of many of the salts in common use make very pretty objects when seen under the microscope and some of them are easily prepared. It is well to become acquainted with them. Take a little table salt, dissolve it in water and place a drop on a slide, spread



it evenly and let it dry. In a few minutes many square crystals may be seen (fig. 1 *m*). As a rule the longer the crystals are in forming the larger they will be. Alum treated in the same way gives crystals as shown in fig. 1 *h*.

Bicarbonate of soda, [common baking soda], when dissolved in cold water and allowed to dry slowly forms crystals like those shown in fig. 1 *s* and *t*. If dried by holding the slide over a lamp, the crystals are imperfect and much like the center of fig. 1 *s*.

To prepare a slide of sugar crystals dissolve a little sugar in water to form a thick syrup, spread it on a cover-glass and dry quickly over a spirit lamp. When dried put in a damp place for twenty-four hours, or more, when crystallization will have taken place. The



crystals should always be formed on the cover-glass when one wishes to make a permanent mount and every trace of grease must be removed by cleaning with liquid potassæ or ammonia immediately before using. Always very great care must be taken that none of the agent be left upon the cover-glass, as it may interrupt and change the shape or position of the crystals or even alter their form. The same crystals may present many different forms according to the conditions under which they are

formed. In fig. 1 *n* are some of the simplest forms of sugar crystals.

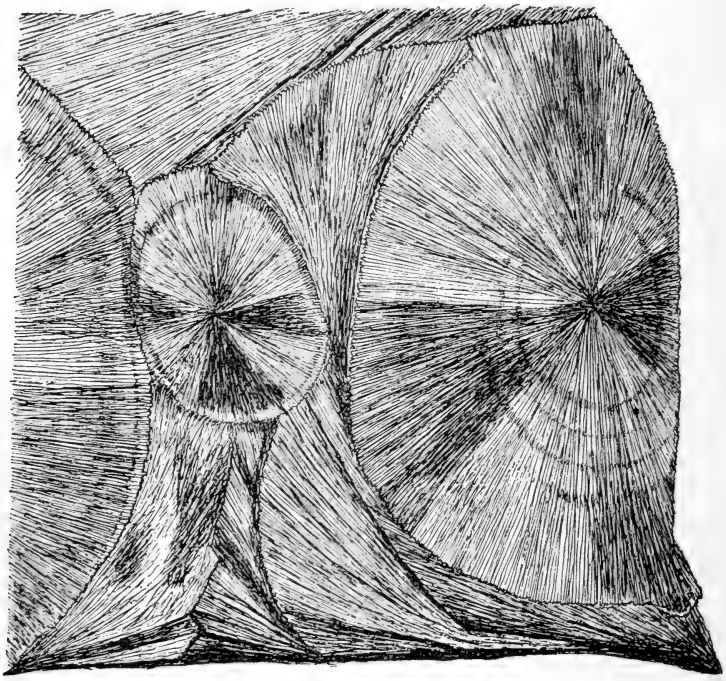
Some kinds of ink, if spread on a slide and allowed to dry slowly, produce crystals. Stafford's ink which had stood for some time produced the crystals shown in fig. 2, but a slide made of some recently purchased gave only a few crystals and those principally in toothed lines. This polarizes well.

Chlorate of potash makes a pretty slide. Dissolve some of the potash in a little water and spread a drop on a slide. Let it dry in a cool place and it will give tabular crystals (fig. 1 *k*). If a permanent mount is desired, dissolve some small pieces of gelatine in about as much distilled water, make a saturated solution of chlorate of potash, add a few drops to the gelatine and stir gently with a glass tube, being careful not to form bubbles, then spread a drop on a cover-glass. If in a cool place it will dry in about half an hour. If the crystallization has been successful a slide may give such forms as are seen in fig. 3. The crystals shown in fig. 4 were found near that shown in fig. 3 *b* but were so small as to appear simply as points of light with the same magnification as used in drawing fig. 3. Fig. 1 *i* represents one branch of a tree-like pattern which was found in another slide. To form these dentritic or tree-like crystals, heat a drop of the solution on a slide over a spirit lamp and as soon as the crystals begin to form at any point, tilt the slide so that the water will run off. Then continue the crystallization by gentle warmth. By comparing these different forms of this crystal it will be seen how easily they might be mistaken for crystals of different salts. Chlorate of potash gives fine colors with the polariscope.

Fig. 5 represents a group of sugar crystals taken from a slide which contained fifteen similar groups;

the edges seemed to touch but not over-lap. Around this central mass were a few of the simpler forms. With the polariscope sugar shows many brilliant colors.

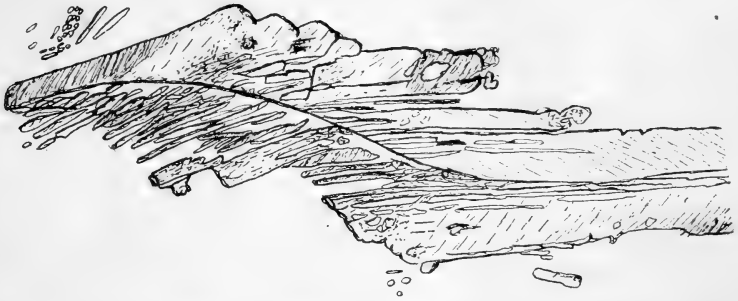
To make a slide of tartrate of soda take a strong solution of tartaric acid and neutralize it by the addition of carbonate of soda. Spread this on a cover-glass and warm but not boil. This must now be laid in a dry place protected from the dust and in from two days to



two weeks some of the slides will prove beautiful objects. Some never crystallize. The one shown above polarizes so that on revolving the polariscope the colors revolve around each center like so many wheels.

Nitrate of uranium, in a solution of six parts water, crystallizes in rhombic forms, but from a solution three parts water containing much fine nitric acid it forms

florescent needles. The slide from which the one shown below was taken gave many needles and detached crystals arranged similarly to the small ones in the part giv-



en. There were several as large or larger than the largest part shown. It polarizes well.

Two salts may sometimes be combined with good results.

Diptheria Anti-toxine.

By C. HADLEY CARLSON, M. D.,

SAN FRANCISCO, CAL.

[Report of an address before the San Francisco Microscopical Society, April 16, 1895 by Wm. E. Loy, Secretary.]

Anti-toxine is a preparation from the blood serum of a perfectly healthy horse, into whose circulation has been injected the toxine of diptheria. It has long been known that patients who have recovered from infectious diseases exhibit a greater or less degree of immunity to future attacks; and for centuries it has been the custom to artificially infect with genuine smallpox, which running a comparatively light course, rendered the person so treated proof against future attacks of fierce epidemics. Vaccination, as now administered, consists in inoculation with an attenuated or modified form of the agent that causes variola. The discovery of vaccination is the

foundation on which rests that structure of modern genius—serum-therapy.

Workers have been unceasing in their efforts to discover protecting agents for other infectious diseases. The development of bacteriological science in the past twenty years has shown the essential etiological factor of many of these maladies. It was evident that in every disease in which a past attack protected the patient against renewed infection, there was exerted on the tissues an influence, either by the morbific agent or its products, which rendered it difficult or impossible for the germs to again flourish. Pasteur was the first to procure immunity from certain animal scourges, as anthrax and fowl cholera, using the method of inoculating them with attenuated cultures of the organic causative agent of the disease.

The second method of bacteric-therapy is entirely different. Behring discovered that in diphtheria and tetanus, substances that destroyed or counteracted the poison were found in the blood of immunized animals, and by these substances a preventative vaccination, as well as a cure of those already attacked, may be affected. These substances were found to be as specific as the living organism causing the disease and the poisons produced by them. The doctor then gave the various facts or points noted by Aronson, upon which facts this system of serum-therapy is founded, also Behring's summing up. Among these points of general interest to the public, it may be mentioned that larger doses of the anti-toxine are never injurious, but on the contrary can only be benificial ; that each blood anti-toxine is immunizing and curative only for one infection, and that as anti-toxines are soluble bodies, they may eventually be produced outside the living body, or even be compounded synthetically.

It is especially in diphtheria that the anti-toxine method has been extensively applied and its results carefully tabulated. Statistics have shown a reduction of the death-rate from about 40 per cent to 13 per cent in epidemics of equally widespread prevalence and virulence of type. Of all animals fit for furnishing anti-diphtheritic serum, the one most used is the horse. He is the most easily immunized; bearing the toxine better than other animals, he is capable of furnishing large quantities of anti-toxic serum at short intervals, and his serum appears comparatively inoffensive to animals and man. The horses employed are carefully examined for evidence of organic disease, especially of the kidneys, and are subjected to an injection of mallein to ascertain if they have glanders. Their healthy condition being established, the injections are made into the skin of the neck or back of the shoulders. Having the animal brought up to a certain degree of immunity, the next step is to keep him there, or improve the strength of his serum by large doses of very virulent cultures. Finally, the horse having been found in a satisfactory condition, the blood is withdrawn from the jugular veins, through a sterilized canula, into sterilized vessels and allowed to separate. The resultant serum is then passed through an unglazed porcelain filter and transferred to sterilized bottles for use.

The Origin of Clays in New Jersey Containing Diatoms.

By ARTHUR M. EDWARDS, M. D.

NEWARK, N. J.

In the course of my perigrinations about New Jersey during the last four years, in searching for geological phenomena, I have observed phenomena which relate to the Bacillariaceæ. These wide-spread phenomena are known to microscopists alone. The geologists know

their value and how important a knowledge of the Bacillariaceæ is when studied this way.

I have gathered the clay in various parts of North Eastern New Jersey during the last four years. I had it collected and collected it myself in New Hampshire in 1873 and I had it from other spots in this country and abroad and I looked for a geological reason for the appearance of these so-called fresh-water, subpeat, or lacustrine sedimentary deposits known as Diatomaceous. I knew that they contained more or less of clay but I did not find out how they came geologicaly until now. I found them always to be associated with glacier ice.

This ice age is a rather recent phenomena but how long it lasted is not known. Suffice it to say that in the Eastern United States there was but one glacier extending from the pole to the 40th degree of parallel.

I have gathered clay from a point eight miles above Paterson city to New Brunswick and from the Hudson river to above Morristown and I found it always the same, resting beneath a thin covering about six inches to a foot thick of alluvial and about three feet to over ten feet thick upon the gravel, the red sandstone moraine of the geologist. This moraine is very thick, over thirty feet in some places. I have gathered the clay in hundreds of places and always found it to contain Bacillariaceæ, the same essentially in all cases.

I gather from this that the clay was formed from the granite and other rocks in the North and North West. The clay is common in large quantities thicker at some places where it settled to form kettle holes which were first known as fossil Diatomaceous deposits. They are common in New Jersey, New York, Connecticut, Rhode Island, New Hampshire and New Brunswick and such deposits as Wecquahick Lake in New Jersey, and Bowkerville in New Hampshire are called kettle holes.

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CHARLES W. SMILEY, A. M., EDITOR.

Remember the A.M.S. meeting at Ithaca Aug. 21, 22, 23.

EDITORIAL.

Professor Lighton's Slides.—From further information we are able to speak more decidedly than last month regarding the stained diatoms. We have got hold of a slide that Mr. Lighton sold for fifty cents and have received a slide from him that presumably represents his best work.

Even in the latter case his slide has had one end broken off in the mails because of slovenly methods of transmission. He does not pack his slides in boxes or slide-holders, but having whittled two pieces of wood to a size one-fifth larger than a slide, he puts the slides between these with layers of blotting paper between them. Then with no protection on the sides or ends he wraps in paper and gives to the mails. It is absolutely indefensible to resort to such methods in order to save the two or three cents which suitable packing would cost.

As to price. Lighton charged fifty cents for these slides. A few years ago that would have been permissible, but today the price as compared with other slides is exhorbitant. The slides of Sinel and Hornell, and those of Watson and Son which sell for fifty cents are greatly superior to Lighton's. Twenty cents each would be enough to ask for the latter.

In response to our request to be furnished with the identical

slide that a subscriber indignantly returned, Prof. Lighton sends it and says: "The mounting medium was not hard when sent and the cover-glass was pushed from place and by some means a little fiber of wool is under the cover-glass. This must have happened when the slide was broken in the mail bag." Surely, Prof. Lighton must have learned before sending to us this last package that his method of packing was bad and responsible for much harm. And still he does not abandon it!

The slide certainly contains some stained diatoms and an enormous amount of foreign matter. No wonder the subscriber caricatured it as "stained dirt." He had a right to expect for fifty cents something very different from what he received. Added to these facts, he complains that when he wrote to Lighton complaining, the latter was exceedingly dillatory in answering.

Prof. Lighton says that he had no trouble in selling out the whole lot, another proof of the patience and good nature of Americans, since only one subscriber has written to make complaint. The money could have been spent far more profitably in our opinion.

Tuberculosis transmitted.—On May 8, 1895, Dr. James M. Byron, a well-known bacteriologist, died in the N. Y. City Hospital of tubercular consumption. More than a year ago, he contracted the disease in the Loomis Laboratory while examining the tuberculous sputum of patients. He was a skilled microscopist and made many examinations during the cholera scare of 1891, as well as of suspected cases of tuberculosis. The bacilli are harmless when examined wet but when dry many float in the air and get into the lungs. He admitted months ago that he had carelessly infected himself by allowing the dry particles to get into his system. He discovered by his own examinations of his sputum that he had the disease and did not at once drop all work and hurry to high, dry latitudes which are known to be favorable to recovery. He sacrificed himself at the post of duty at the early age of 34, having been born in Peru, July 24, 1861.

Subscribe for the Microscopical Journal, only **$2.00.**

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

225. *Is there any apparatus for making enlarged photos of minute insects? How could a house fly be photographed to ten times its natural size?—F. L. H.*

Any microphotographic outfit will produce photos of insects or any other micro object. A sufficient light and a proper extension of the camera body will give any size of picture desired. A one inch objective at 12½ inches distance from the ground glass, or a two inch objective at 25 inches, will magnify an object 10 diameters.

226. *How can I best get micro-photographic apparatus to fit on a tube vertically so as to photo objects mounted temporarily such as the desmids, diatoms and eggs of insects?—F. L. H.*

Arrange a small platform with a central hole for the microscope tube to pass easily through, and fitted with legs, like a stool. Place the camera, front down, on this support, fasten the camera to the platform with screws; or if preferable, nail strips of wood to keep the camera central and allow easy removal. When the microscope and object are ready, place the platform and camera over it and focus the object on the ground glass as usual. Objects in fluid will require extreme steadiness of apparatus and a cloth-screen around the lamp, so that exposure can be made without causing vibrations in the object or camera.

227. *Do you hold to the good opinion of Friedlander's Microscopical Technology by Howell, expressed in The Microscope of January, 1887?—M. D. J.*

Dr. Stowell was the editor at that time and expressed the opinion. We are not acquainted with the book. Doubtless the advances in knowledge since 1887 have rendered it somewhat obsolete.

228. *Where can I obtain a catalogue of Microscopes manufactured by Siebert?—W. G. T.*

Cannot say. Can any subscriber give the information?

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

How to Examine Mosses.—To properly analyze mosses, an American Bryologist should pos-ess "Mosses of North America" by Lesquereux and James and the "Artificial Keys to the Genera and Species of Mosses" by Charles Barnes. There are many other valuable books on the subject, but these two books will furnish a satisfactory foundation for a start. Without a compound microscope the work is impracticable. For study only ripe and mature mosses should be selected. The first thing that will command the attention of the microscopist will be the capsule. Cut this off close, soak it in water, remove it to a slide, gently remove the calyptra, cut the capsule just below the tip and examine the teeth, cilia, and annulus. These are all beautiful objects. Remember that mosses are very delicate and that rough handling will often destroy the part desired to be seen. If the calyptra be refractory and refuse to come off, boil the capsule for a few moments on a slide in a drop of water. Then the leaves are worthy of attention; are they smooth or papillose? Are the alar cells different from the rest? Is the margin entire or otherwise? Is the point acute, murcronate, or accuminate or what is its form? Is the leaf costate or ecostate? There are many other interesting points to be noted that require a special work upon the subject to treat them properly. The best mounting medium for mosses is glycerine or glycerine gelly but it is better still to keep them in boxes and examine them in water under the 'scope when occasion may require.

A Convenient Receptacle for Diatoms and Butterfly Scales.—Any one, desiring to keep diatoms or butterfly scales for mounting and arranging in forms, can make a convenient receptacle as follow:—Fix an inch or three-eighths inch brass ring to a glass slide; inside of this ring make several inscribed asphalt rings. Use these inscribed rings as the receptacles and

keep each kind of diatom and scale in a separate asphalt ring. The best means of placing the objects in these rings and removing them therefrom is a mechanical finger; but it may be done with a bristle, cat's whisker or a fine spun piece of glass mounted in a crochet needle holder. The latter work will be facilitated with a dissecting microscope, but with time, patience and perseverance, it may be accomplished with a hand lens. Before attempting to pick up, spread the objects on a glass slip and let them dry before attempting any manipulation.

Æcidiacei or Cluster Cups.—This is the season for seeing these beautiful objects. No amateur microscopist who has not beheld them should fail to exhibit a few specimens under his microscope. They burst forth in the spring always on living leaves. The host plants where they may be found are legion. Among other hosts may be mentioned pear leaves, Juniper leaves Scotch Fir, Silver Fir, the wood Anemone, violet leaves, leaves of Goat's beard, Berberry, honeysuckle leaves, nettles, mints, garlic, &c. No more beautiful objects for the microscope can be obtained.

Striated Muscular Fibres.—These can be nicely seen with an inch lens in the muscle of almost any insect. Dissect the insect under water and remove some of the tissue to a slide and examine. The striations will resolve beautifully. For permanent mounting, place the fibres in glycerine. In Klein's standard work on histology the striped muscular fibres of the water beetle (Hydrophilus) are employed as a typical specimen to illustrate human histology. A small particle of meat picked from the teeth, after dinner and placed upon a slide will often beautifully exhibit striped muscular fibre.

SCIENCE-GOSSIP.

Structure and Animal Origin of marble.—Sections of marble and other minerals may be prepared by grinding one side of a slide, to which the object, which has been ground and polished on one side, may then be cemented with hardened balsam. The grinding is done on a plate of glass by the use of emery of different degrees of fineness. The specimen is then

ground down to the proper degree of thinness and need not be removed from the slide.

A true marble is a crystalline rock, rendered so by the action of heat, moisture and pressure, which has changed its texture from that of a common sedimentary limestone to that of a crystalline rock in which all traces of animal life have been completely obliterated.

Of the sedimentary limestones there seem to be two kinds, one having the fossil remains well preserved and another in which no signs of life can be discovered. In this case it is not to be inferred that the limestone was not of animal origin. There are good reasons for believing that the minute forms of life which would, under other conditions, have made up the rock in a well preserved state, have been dissolved out or disintegrated by water highly charged with carbonic acid. This is especially true of the calcareous shells of foraminiferæ, which minute animals live in a stratum of water near the surface, and, as they die, fall in showers to the bottom, to form, under favorable conditions, beds of chalk or limestone full of well-preserved delicate shells.

But if the water through which they fall is deep, and under pressure of that depth highly charged with carbonic acid, they would be dissolved before reaching the bottom; or having reached the bottom, they may in process of time become completely disintegrated, losing their characteristic forms. Prof. W. C. Williamson has given an example confirming this view. In a slab of marble containing a large nautaloid shell there were, in the innermost chamber, foraminiferæ preserved in the most exquisite perfection, while outside of the shell, where the ooze must have been identical with that in the inside, there was a more or less complete disintegration of the foraminiferous shells. Those in the thick nautiloid shell had been protected by it.

Again, of the limestones having the fossils more or less perfectly preserved, there are two kinds; one with the interspaces filled with finely comminuted particles of other fossils, and the other with them filled not with a mud-like matter, but with clear, glass-like calcareous spar. This was doubtless deposited from water holding calcareous matter in solution, but whose solvent power was diminishing, perhaps by passing from greater

to less pressure or by condensation in a sea growing more and more shallow, and being thus compelled to give up more and more of its calcareous matter. —JOHN BOLTON *in P. M. Club.*

Cephalopods as Food.—Several kinds are thus used abroad At Naples they are sold ready cooked, and they are found in the markets of Smyrna and India. In Japan squids are regularly collected for food. In China they form a common side dish, and are eaten fresh, boiled or pickled; in the latter condition resembling the edible birds' nest in substance, color and taste. In Madrid they are eaten broiled or stewed in red wine in a jar. On the coast of France the Loligo sagitta is eaten and said to be "exquisitely fine and delicate."—*S. G. Shanks.*

CORRESPONDENCE.

I am much pleased with your publication "THE MICROSCOPE" and wish I had more time to spare for study. I have one of Beck's binocular microscopes which with accessories cost $1200, including objectives 3 inch up to 1-10 inch immersion.—T. H. H., (Cal.)

The slides ordered through you of Mr. Hornell have arrived safely and I am very much pleased with them.—O. E. S., (Wash.)

RECENT PUBLICATIONS.

Le Naturaliste Canadien.—We can conceive no better way to benefit and interest young people who know just a little french and a little natural science, than to give them a monthly magazine published in the French language and treating topics in science. *Le Naturaliste Canadien* is a 16 paged monthly, size of THE MICROSCOPE at $1.00 per year by M. l'Abbe' V. A. Huard, who lives in a locality far north of Quebec on a tributary of the St. Lawrence. A railroad reaches Chicoutimi, but a train runs up there only twice per week! and yet, this is said to be the only scientific periodical of its kind in Canada.

Any of our subscribers may send us 15 cents for a sample copy or $1.00 for a year's subscription and we will forward it to to our French collaborator.

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FOR SALE.—Crouch Intermediate binocular, circular glass stage, mechanical centering on substage, four eye pieces, achromatic condenser polarizing attachment, stops for dark ground and oblique illumination, parabaloid, two solid eye pieces made by Spencer. All in perfect order and have been used very little. $100. GEO. A. BATES, Auburndale, Mass.

FOR SALE.—Barbadoes Earth, containing many rare forms of Radiolaria. Send 40 cents, stamps, for inch cube of this material to
S. S. DAY, 23 Olyphant St., Morristown, N. J.

THE MICROSCOPE.

JULY, 1895.

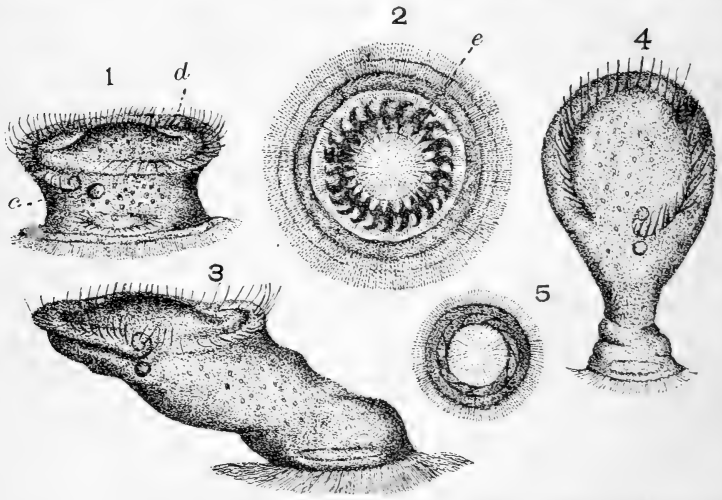
NUMBER 31. NEW SERIES.

The Trichodine Infusoria, a Parasite of the Fresh-Water Hydra.

[Translated from "Le Naturaliste."]

BY CHRYSANTHEMUM.

The fresh water hydra, the most simple of all polyps, lives in all ditches wherever running water bathes the lemna and other aquatic plants. To obtain them, it is sufficient to take a handful of the plants, press them



between the fingers and collect in a glass vessel the water which flows from them.

The next day, one will be almost sure to see against the transparent sides of the receiving glass some little green and brown thread-like bodies, terminated by a bundle of fine grasping filaments. These are the hydra.

The hydra is always accompanied by a parasite, or rather an habitual guest belonging to the class of ciliated infusoria, and which, on account of the singularity of its way of walking, has received the name of Trichodine Louse.

It is easy to observe and study it by taking one of the polyps, placing it in a drop of water upon a glass slide and submitting it to a magnifying power of about 250 times. One then sees moving about upon the whole surface of its body and arms some little animalculæ whose general form reminds one very much of a quoit or disc. These discs seem at first sight to touch each other slightly on the surface of their host, to slide lightly against him without touching him, and one asks himself by what mysterious phenomenon—by means of what organs—do they keep themselves erect and move about with so much facility. A closer examination will show.

The Trichodine presents, as we have said, the form of a quoit, or one of the surfaces of a quoit (fig. 1). That one which is turned toward the covering of the hydra is admirably formed for adhesion, the other is adapted to obtaining nutrition. In looking at the upper surface, while in a state of extension and immovability, this infusoria presents to us a circle of hairs analogous to those of the vorticella, but of which the direction is just the opposite. This is rather a hairy tube (fig. 1) which is used to conduct the food to a cavity upon one side of the body (fig. 1, *c*). At the bottom of this cavity is the mouth. The portion comprised in the circle, and which constitutes the upper disc of the quoit, may, according to the movements of the animalcule, either take a concave form or, on the contrary, enlarge itself into the form of a dome.

If now we pass to the study of the lower or adhesive

surface, we find (fig. 2), surrounding the edge of the disc, a crown of cillia, thickly implanted, constituting a movable collar, the motions and undulations of which permit the organism to move itself by turning rapidly upon its axis. But these hairs present still another property. Strongly adherent to each other, somewhat in the same way as the barbs of a feather, they act as a circular membrane susceptible of attaching itself to surfaces and of holding itself firmly there. This action is still more easily accomplished because at the very base of the fresh water hydra is a true collar, which much assists them.

The Trichodine, when it wishes to attach itself, applies its membrane and ciliated collar to the surface of the hydra. Then, hollowing the under surface of its disc by voluntary contraction, it transforms itself into a true cup-glass, comparable to those well-known adhesive candlesticks which one can stick against a glass, or to the proboscis of the octopus.

But the central part of the contractile disc of the Trichodine does not consist of a simple protoplasmic membrane. We find there a true organism, surprisingly well made for a being so low in the scale of animal life.

Let us press lightly upon the cover-glass of our preparation, in such a manner as to detach some few of the parasites, and let us choose from them one which presents the under surface.

We find then that this surface is formed of a cup very finely striated, and that its concavity increases or diminishes according to the contraction of the body.

In the thickness of the wall of this cup, is a toothed wheel (fig. 2, *e*) of the greatest delicacy, which sends from the side toward the center some fine radial prolongations. From the side toward the circumference it

presents some teeth imbricated with geometric regularity. The toothed wheel of the Trichodines surpasses in regularity and fineness the most precise work of watchmaking. It acts as an organ of support, and possesses, with the striated cup, the property of giving to the body of this being the rigidity of which it has need. The Trichodine, like all ciliated infusoria, multiplies itself by direct division. Its entire body separates itself in two equal parts, which form two new individuals similarly constituted. In this process, the ciliated membrane, the striated cup and the toothed wheel undergo a common destiny; they separate themselves and divide themselves, showing by this that, in spite of their apparent rigidity, they are formed of a still living protoplasm and not of a substance secreted by the hydra.

Such, in a few words, are the characteristics of the parasite of the fresh water hydra. The Trichodines, discovered and described by Trembly as the louse of the hydra in 1744, can be taken as a type of a numerous family of ciliated infusoria, the Urecolaires (fig. 3), whose common characteristic is an adhesive organ, more or less complicated and analagous to the one we have been studying.

In some of these species (figs. 3-5) the toothed wheel is replaced by a simple ring of support; in others a membrane complementary to the collar takes the place of the long, stiff hairs which stand up around the body, but all live as parasites upon the surface or on the internal organs of aquatic animals of either fresh or salt water. Fig. 4 shows Liemophora, a parasite of Ophiura squammata. Fig. 5 represents the interior of its adhesive disc.

The meeting of the American Microscopical Society at Ithaca August 21, 22, 23 will exceed all others in interest. Be sure to go.

How the Change in Color in Petals Takes Place. Keeping Notes. The Brownian Movement.

By ARTHUR M. EDWARDS, M. D.

NEWARK, N. J.

I have been looking over the memoranda of microscopic observations I keep and have kept for over thirty years and find amongst them things that will bear reproduction now and here. And here, by the way, I wish to recommend the keeping of such a book by everyone who observes nature. It is good to put down everything that you see. Never mind how insignificant the facts seem at the time they are recorded they may start a train of thought then or in the future that may bear fruit that will ripen into a luscious apple or pear of promise. After years I have found that a recorded fact is valuable and can hitch on to a train that will bear me along to a station I have been aiming at for a long time. The notes can be illustrated, never mind if you cannot draw, an illustration will convey the idea that you want better than a whole page of letter press. Colored illustrations are necessary many times and I color them at the time. Another color may supervene and another colored illustration will be necessary. Never mind how much labor it requires. It will tell.

I was reminded of that when I was looking over some notes of mine made in May 1867. They were on the examination of the petals of *Weigelia rosea* the beautiful colored china flower that we have so common in our gardens. The petals are some of them rose colored and some of them white or nearly so. And I wondered why the petals were rose colored when they open and always change to a lighter tint before they fade. I split a petal in two and put it in water on the stage of my microscope and viewed it by means of a ¼ inch objective and a 1 inch

ocular giving me a magnification of 400 diameters.

The petal was pink outside and white inside and the microscope revealed the fact that the white cells were inhabited by a transparent colorless liquid without anything to mark it. But the pink cells had swimming in the colorless liquid what I called then "oil globules" which were colored some darker and some lighter pink. These larger "oil globules" are in number one, two or three and are perfectly quiet, or move about with a slow motion like that of granules which appear when ripe pollen is wet with water. That is to say it is what is known as Brownian motion, and to understand what is Brownian motiou we can imagine a mass of semi-solid white of egg is dropped into water. Now it does not rest quiet but moves about sometimes this way and sometimes that without any means or paddles. And this it does for weeks or years at a time.

This is Brownian motion and was so called because it was first described by the celebrated Robert Brown in a paper published in 1827. It is now known as *pedesis*, and can be seen even in the contents of fluids in the oldest rocks. The contents of the particles in these have been going on most likely for æons. When I lectured on chemistry in the New York Medical College for women about thirty years ago I was in the habit of explaining Brownian motion by likening it to a globule of Sodium dropped on water which seems alive and moves about in a lively manner. The motion here is chemical and it is likely that all motion is accompanied by chemical action. But, however that may be, the motion of the pink particles in the cells of *Weigelia rosea* is also Brownian. Congregating around these larger "oil globules" there are numerous smaller globules, pink in color and more vigorously in motion. In time the large globules become larger by gradual coalescence of the smaller and in time

they all disappear and the larger globules become transparent and colorless. In this way the petal becomes transparent. Can this be the way that colored petals become transparent and can this be the chemical change that the cell contents undergo? It set me to thinking that perhaps it was. At any rate the observation is interesting and suggestive. These "oil globules" are the same, that is to say have the same general character as the "oil globules" in Bacillariaceæ (Diatomaceæ) but differently colored, and with them are also smaller active granules. The former are the representatives of ova or female granules and the later are the anthozoa or male granules. Can reproduction take place in the cells of *Weigelia* also? It will bear thought.

PROCEEDINGS OF THE A. M. S.—Just as we go to press (June 18), we have received Part II. of the Proceedings for 1894–95. It is labeled "January" and "issued quarterly." It is now just three months since the number for October, 1894, was issued (March 18). The October number was five months behind time and so is the January number. The delay can hardly be due to the wealth of material involved, since not a dozen articles have been printed in both numbers.

The present number contains: The Structure of the Fruit in the Order Ranunculaceæ, by Wiegand; Limitation of Tuberculosis, by Alleger; A Marker, by Prof. Gage; Laboratory Methods, by Krauss; New Section Instrument, by Bastin; and new Cover Slip Forceps, by Gaylord.

The substance of nearly all of these papers has long ago been published by us. One of them, that by Dr. Alleger, on Tuberculosis, was printed in full in the *Journal* and in several Brooklyn papers last year.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Viewing the Astral Body.—In a book by J. C. Street of Boston, called "The Hidden Way Across the Threshold" is given the following account.

Believing that there was within and about the natural body another body of etherial character, he concluded "that a simple microscopic device could be made that would assist the eye so that it might penetrate the most minute particles of the air we breathe, and thus witness the Soul and this etherial form take flight to the boundaries of the other world."

"Procuring the most powerful lenses I could find, I completed an invention of my own and, when my light was so perfectly arranged that I could examine the microbes in the air, I called a patient who had lost an arm and asked him to put his imaginary hand where I directed. The moment I adjusted the glass, a new world and light of revelation broke upon me. *The real hand lay beneath my glass!* I asked him to make letters with his imaginary finger. He did so, and, to his wonder and astonishment, I spelled out the sentences he thus wrote. This was to me conclusive evidence of an etherial second self."

Perhaps some of our readers can tell us how to examine "the microbes in the air." We have thus far been obliged to catch them and confine them under a cover-glass in order to see them.

Again, we ask how can it be arranged unper so high a power to get a human hand into the field of vision. It is ordinarily supposed among microscopists that not over the size of a needle head can be observed at once under the highest powers. To see a finger is practically as impossible as to see a hand. Unless the words were written too small for unaided human vision, they could not be brought within the field of vision at one time. But to write so finely with a finger or even a pen is an impossibility.

"The second," he says, "was one of great difficulty." Having heard that the astral body leaves and the soul departs at the moment of dissolution he watched for an opportunity to observe. "The time finally came where I had proper conditions of light, etc., where a man of more than ordinary spirituality was being called over to the silent majority. When he was about to cease breathing and a sudden tremor passing through his body announced his hour had come, we (two obervers) passed our heads under the black cloth and bent our eyes intently upon the object glass. Particles of dust in the air were magnified several thousand times, and for a time their motion kept a perfect dazzle upon the glass. Then a thin violet column of vapor gathered into a soft cloud apparently formed over and about the body. Particle seemed to seek particle as if by some molecular attraction, until the outline of an object was clearly distinguishable. As it grew stronger, it seemed the vapory form of a man rapidly assuming a more perfect shape, pure and colorless as the most perfect crystal, having changed from the violet tinge. There was at this moment an awful stillness. An indescribable feeling came over us. Words are inadequate to describe our feelings. We bent our eyes intently on the glass until particle after particle came into the shapely form of the man we knew so well.

It lay floating about a foot above the body, apparently moored by a slender cord to the breast of the corpse. The face was the face of the man, but far more peaceful and beautiful in expression; the eyes were closed and the new form apparently seemed asleep. We wished he might awake, when the cord that held it to the clay house parted, a gentle tremor passed through the beautiful form, every limb of which was of a per-

fect mould; a violet flame was radiating over the heart, a kind look over the gentle face. The form arose to a standing position; cast one sorrowful look at the tenantless clay that lay so still; extending a hand as it were to say, 'Farewell, thou narrow house; I need thee no more,' it gathered its forces into a little sphere and passed out into the sunlight of the everlasting morrow."

If such astounding phenomena had been observed with camera, for the intimation is that a camera was used in the latter experiment, why have not the details of apparatus been described in the scientific periodicals? The author attributes this account to a scientist who had patents—hence to a physician. Why have we not been furnished with particulars from a scientific standpoint? Why has J. C. Street, of Boston, been peculiarly favored with what to the average scientific mind is an impossible scientific arrangement? And why, in a reputable book of 598 pages, published by Lee & Shepard, and claiming to contain truth and wisdom, are we confronted by such incredible stuff? Does Mr. Street know that he discredits this entire volume by giving us what we can but regard as one piece of humbug? If there is a single microscopist or photographer who credits for one moment the possibility of arranging apparatus as described, will he please to so inform us?

We are not intending to call in question the occult phenomena which the operator claims to have witnessed. Let that all pass to be believed or disbelieved by people who feed on belief or disbelief. The only issue we raise is that such account as Mr Street furnishes of the apparatus is absurd, and not only unknown to scientific men but incredible in the present stage of progress. We need a full and consistent account of the apparatus and the manner of its use. That is all we care for. Given that, we will find out for ourselves what phenomena can be observed with it, and when found out we will exhibit it to others. Then they, as well as we, shall KNOW what we have seen and have no occasion for belief.

The wholesale manner in which the word science is being used by charlatans of every description is amazing. Honest men should beware how they allow themselves to be misled by mere words. When they find that a writer has either intention-

ally or inadvertently fallen into such methods, they should not accept anything he says unless they have independent means of verification.

Commerce-blackmailing.—On February 28, Messrs Watson & Son, who have been doing the colleges of this country a great service by supplying microscopes at much less cost than they could be made in the United States, sent us an electrotype to replace the one now used in this advertisement. The electrotype, which in this country of high prices and idleness would cost about $1.00, cost in London 62 cents. The commerce-blackmailers in New York affixed a duty of $1.73 which we have refused to pay. The matter has been referred to the Secretary of the Treasury. Running behind as he is every day in the finances of the country, he may refuse any rebate. But if Democrat Carlisle permits such outrages as this, pray what might we expect from McKinley, the prince of commerce-blackmailers. As Bob Ingersoll says: "If God commanded the Hebrews to slaughter 50 000 Amelekites, their wives and children, what might we expect the Devil to do under similar circumstances?"

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

Equisetum.—These plants are commonly known as horse tails, or scouring rushes. They are simple leafless stems or stems with whorled branches and are found growing in wet grounds, lake banks, river banks or border of woods. They furnish interesting objects for the microscopist, such as the elaters and spore. These are found in a terminal cone-like spike of the fruitful plant. Gather a quantity of the stems and on arriving home shake them over a paper and preserve the resulting dust by having it wrapped in paper. When it is desired to examine the elaters and snores, place a small quantity of this dust upon a slide and examine it without a cover-glass with an inch objective. While looking through the tube have a friend breath gently upon the slide when the elaters will spring into

life and action and appear under the scope like a lot of brownies.

The next interesting part is the cuticle which is composed largely of silex. Cut off portions of the cuticle, of suitable size for mounting; place them in a test-tube half full of water, add a few drops of nitric acid and boil for a few minutes over a spirit lamp. This will quickly and easily separate the siliceous cuticle which then should be placed between two glass slips, held together by a brass clip and left to dry. When perfectly dry mount in balsam and examine with polariscope, A beautiful slide will result.

Starch.—Starch may easily be obtained by taking the object containing it and reducing it to a pulp, or powder. For potatoes or seeds a nutmeg grater will effect the proper reduction.

Then have at hand a proper receptacle in which to place a funnel covered with a cloth. Place the pulp, or powder upon the cloth and pour water upon it, the starch will settle at the bottom of the recepticle. Before mounting the starch should be thoroughly dry when it may be transferred to balsam and furnish an instructive object for the polariscope.

Thin Sections of Woods.—These may easily be prepared by taking a pine board into which have been bored a series of holes of sufficient size to contain the specimens of which sections are desired. Insert plugs of the woods into the holes thus prepared and make the sections with sharp jointer plane.

Fibres.—Fibres of silk, woolen, cotton, linen and other fabrics should be teased with needles until they exhibit their natural and original cells. Manufactured threads are composed of many fibres woven or twisted together. After teasing, place on a slide, moisten with a drop of water, cover, and examine with a power equal to a quarter inch objective. A little experience will enable one to determine the nature of the fibres at a glance. Fibres of different substances act differently when soaked in a weak solution of sulphuric acid; it is interesting to soak the fibres in the acid and then examine them under the microscope. This soaking will so differentiate different fibres as to remove all difficulty in determining their nature.

SCIENCE-GOSSIP.

Eye of Beetle for Multiple Image.—Have a diffuse side-light (window with sky or lamp with white porcelain shade between flame and mirrow). Use plane mirror and small aperture of diaphragm. Focus on the piece of cornea; then with one hand held about three feet from the mirror toward the light, with fingers spread and in motion and with the other hand on the fine adjustment, slowly draw the objective back from the slide, watching the facets of the cornea until hundreds of tiny hands are seen. After you have learned how to do it, anything may be substituted for the hand. A profile-face against the sky, a house in bright sunlight, etc. They will not be right side up, owing to reversal in forming the images.—*P. M. Club.*

Starch.—This is one of the substances produced by an actively growing plant, and, like the fat tissue in an animal, it is stored up for future use. The grains are spherical when young but growth being not always uniform, the form becomes ovoid, or of some other figure. When packed away closely, as in the small cereals, wheat, oats, rice, etc., the grains become many-angled by mutual pressure. In the potato the starch grain, attached to the starch-forming corpuscle by one margin, absorbes nutrient sap much as a sponge might absorbe nutrient fluid, and the starchy elements are deposited in greater abundance at the attached (or broad) margin, producing an excentric or one-sided growth, the hilum or narrow end being the distant portion.

Starch grains always occur in all stages of development, and consequently vary greatly in size in the same plant.

Starch, chemically and morphologically, is nearly the same as cellulose. It is a carbo-hydrate. Weak alkalies or acids cause it to become soluble. When it is to become re-absorbed for use in the plant economy, it is in most cases converted into sugar or dextrine, by some of the plant ferment, but occasionally it is only partially dissolved, broken down, and may be detected as starch, in the sap, before assimilation.

Starch when heated to about 400° F. changes into soluble dextrine.

Malting is practically the forcing of germination until the root point is protruded about one-third the diameter of the

grain, then raising the heat and checking further growth. The ground malted grain, if kept in water at a temperature of about 154° F. for two weeks, will become converted into dextrine and sugar, and be dissolved out, leaving only the cuticles of the grain. This action is the result of the diastase developed by the germination of the grain.

Wheat contains 64 per cent of starch, corn 65 per cent., rice 76 per cent, and potato 15–29 per cent—*S. G. Shanks.*

CORRESPONDENCE.

Dr. R. H. Ward, Troy, N. Y., writes regarding query No. 228:—

Reed, Siebert, Alserstrasse 19, Vienna, Austria, makes supplies and magnets, but probably no microscopes.

W. & H. Seibert, Wetzlar, Germany, makes microscopes. Catalogues (probably in German) could be obtained from them by mail.

Purifying Alcohol.—In histological work, especially animal one must make use of more or less alcohol,—absolute, ordinary or commercial and wood spirit. I use all three at times and for various purposes, and as a result have quantities of mixed alcohols vitiated or degraded by water, oils, resins, fats and other organic elements met with in this class of work. Now the question is how to recover the alcohol from this otherwise waste product. Lime disposes of some of the water, distillation of water and as a residue the heavier oils and fats but the first is only a partial success, while in addition the distillation process is expensive. Is there any "royal road" any "cross lots" method by which may be made certain the recovery of this necessary but expensive article? The conditions are that the means all be simple, effective, easy of accomplishment, inexpensive; the result, a comparatively pure product.—*X.*

The Superiority of Direct Illumination.—We are informed that the one seventy-fifth inch of Tolles used with the direct light of a common one-cent spermaceti candle gave a good field and brought out details of human blood dry. Condenser used—a B eye-piece in sub-stage. The same, with re-

flective light gave a field with only one-half or one-quarter of the direct illumination. This proves the great loss of life sustained by using concave mirrors. E. CUTTER.

WHITE'S OBJECTS.—We have just received a large consignment of vegetables sections and can supply all the numbers except a very few.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

229. *In my histological work I use more or less absolute and common alcohol. I have accumulated quantities of weakened alcohol containing fats and other organic elements. Is there any simple and effective method, cheaper than distillation, by which the alcohol can be recovered from this otherwise waste material.* X.

There is no method cheaper and better than re-distillation. Analytical chemists and others, who use quantities of alcohol, usually have some form of automatic apparatus which will run for hours without attention. Remington's still is a good one, and is much used by chemists and pharmacists.

NECROLOGY.

George A. Rex, M. D.—Died at Philadelphia Feb. 4, 1895. Dr. Rex, who was a member of the Phila. Academy of Natural Sciences, was the highest authority on the Myxomycetes in the United States. He frequently read papers thereon before the Biological and Microscopical Sections. He named many new species, but often held specimens for years before naming them in order to be sure that the species when erected would stand. All of the lower orders of fungi interested him. Although a prominent microscopist, he was not a member of the American Microscopical Society. Although a subscriber to the periodicals, he rarely contributed to them.

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FOR SALE.—Crouch Intermediate binocular, circular glass stage, mechanical centering on substage, four eye pieces, achromatic condenser polarizing attachment, stops for dark ground and oblique illumination, parabaloid, two solid eye pieces made by Spencer. All in perfect order and have been used very little. $100. GEO. A. BATES, Auburndale, Mass.

FOR SALE.—Barbadoes Earth, containing many rare forms of Radiolaria. Send 40 cents, stamps, for inch cube of this material to
S. S. DAY, 23 Olyphant St., Morristown, N. J.

THE MICROSCOPE.

AUGUST, 1895.

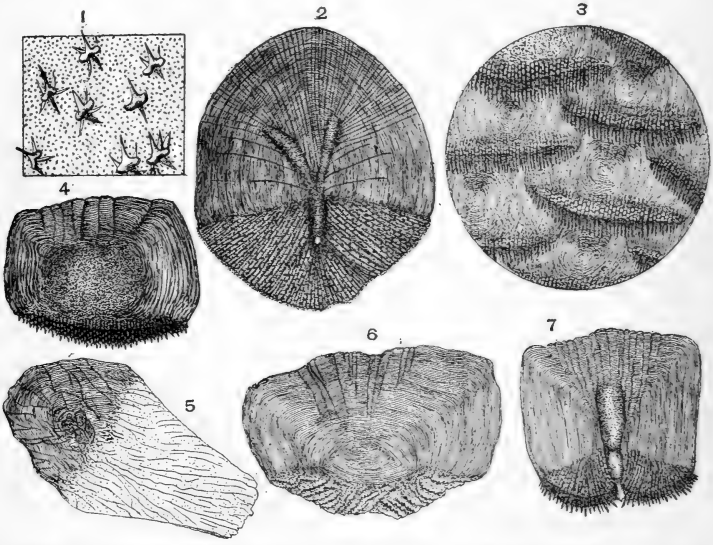
NUMBER 32. NEW SERIES.

Objects Seen Under the Microscope.

BY CHRYSANTHEMUM.

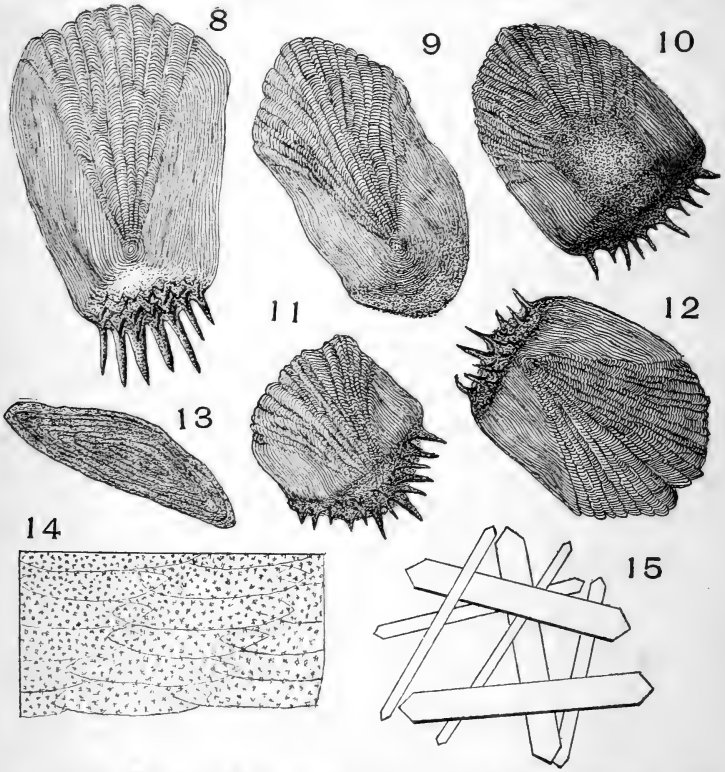
XXV.—SCALES OF FISHES.

The skins of most fishes are strengthened by plates of horny, bony or cartilaginous matter, and when these are so arranged as to overlap one another (fig. 3), somewhat like the feathers on a bird or the slates on a roof, they are called scales. These scales are beautiful and interesting objects when seen with low powers of the microscope.



Some fishes are covered with only a thin layer of skin, in which case the scales can be readily seen; in others they are so deeply imbedded in the skin that we say the fish has no scales, as in the case of the eel.

But the scales are there, and if the under side of the skin be examined after it has been taken from the fish, the scales may be readily seen and removed with a pair of tweezers; fig. 13 represents one of these scales. A piece of the skin of the eel dried and mounted in Canada balsam shows the scales imbedded in the skin, their arrangement and the pigment cells (fig. 14). These, and



indeed the scales of nearly all of our fishes, make beautiful objects for the polariscope. The different scales vary much in color and tone. It is also interesting to view them as opaque objects.

By means of the scales, fishes are divided into four orders, Cycloid, Ctenoid, Placoid, and Ganoid, but most of our common fishes belong to the first two orders.

THE CYCLOID.—The scales are so called because of their roundish form and because much of their surface when magnified is seen to be covered with concentric lines. At the top, where they are attached to the body, these concentric lines are divided by radial lines, sometimes making slight, sometimes deep undulations in the surface of the scale. To this order belong the Salmon, Roach, Gold-fish, Silver-fish, Cod-fish, Minnow, Carp (fig. 2), Herring (fig. 5), Blue-fish (fig. 6), Eel (fig. 3), and others.

Along the side of most fishes is a line known as the lateral line, which is formed by a kind of scale usually more horny than the others and pierced by a tubular orifice having an opening on the upper side near the outer edge and another opening on the under side where it is attached to the body (fig. 7, Salt-water Perch, 5 diam.). In fig. 2, German Carp (2 diam.), this tube divides just above the exposed part, thus having two openings on the under side. It has been supposed that this tube was for the escape of a mucous substance which was poured out from glands beneath, to protect the skin from the macerating influence of the water and to diminish the friction in swimming, but this has been denied.

By carefully detaching a scale from a bright colored fish of this order, and examining the under side of the part which is exposed, we find a layer of soft substance corresponding in color to the color of the first. Remove a little of this to a slide, and by examining it with a power of 300 diameters, we shall find that it consists of two substances. One is a layer of loose membraneous cells containing coloring matter. These lengthened cylindrical cells are arranged side by side and run at right angles to the lateral line. Now, if a small drop of water be added to this mass and it be gently agitated with the point of a needle, the water around will be seen to be full of minute flat spicules or crystals, varying in size

but constant in form (fig. 15). By transmitted light these are so transparent as to be hardly visible, but with reflected light, or the direct rays of the sun, they sparkle like plates of polished steel. Each of these crystals is constantly vibrating and quivering, and giving one the impression that it is alive although taken from a fish which has been dead some days. This motion is probably due to the vibrations of the water, but it gives that beautiful play of light which we so much admire in the Gold-fish, Silver-fish and others. Notice that in the highly colored fish the exposed part of the scale is more transparent than the other portion (fig. 5).

THE CTENOID.—These scales have the same general structure as the Cycloid except that at the exposed end they are furnished with teeth arranged something like the teeth in a comb. In some scales they are small and set closely together as in the Perch (figs. 4 and 7, 5 diam.), while in others they are larger and much farther apart, as in the Sole (fig. 8, 8 diam.).

In some scales the laminæ show as concentric lines on the outer part of the scale only, the interior being somewhat granular in appearance, as in figs. 4 and 10. The scales on a single fish vary much in size and form, figs. 9, 10, 11 and 12 (8 diam.) coming from the same fish, —one that was sold in the market as a Flounder. Fig. 9 represents a scale from the ventral or white side. Figs. 10, 11 and 12 represent those from the dorsal, and fig. 11 one from near the tail. Fig. 5 (5 diam.) is from near the tail of a Herring. Scales from the central portion of the body of the Herring have somewhat the same outline as shown in fig. 7. It is to be noticed in fig. 8, Sole (8 diam.), that the radial lines look as though they had been split in places and the spaces filled in with a clear transparent substance, but this is not the case. It is claimed that if a thin vertical section of a scale of the carp, which is taken as a representative of

the higher orders, be examined with a high power, it will be found to consist of three layers. The uppermost is composed of several concentric laminæ, the outside one being the smaller, and they increase in size, each being a little larger than the one above it, so that their margins appear on the surface as a series of concentric lines and their surfaces are thrown into furrows and ridges. It is these laminæ which we see, and in some of the furrows the laminæ have entirely separated showing the layer beneath them.

Sometimes in Cycloid scales the pigment cells can be seen giving the scale a spotted appearance, as in the Carp (fig. 2) and Eel (fig. 14).

THE GANOID.—These scales are usually bony, often having the same structure as the bones of the fish to which they belong. They are usually angular in form and arranged in rows, the scales but slightly overlaping one another, thus forming a coat of armor. To this order belong the Sturgeon, Lepidosteus and Hassar-fish, but most of this order are found in the fossil state.

THE PLACOID.—To this order belong the Skate, Dog-fish, Ray and Shark, besides many fossil allies. These are not like the scales we have been examining, but are more like teeth and project from the skin as spines. They are much like teeth in structure and are covered with a hard enamel resembling the enamel of teeth. Fig. 1 represents a piece of the skin of the Thornback Skate, showing spines and pigment cells. It can be mounted dry without a cover-glass and viewed as an opaque object and also with transmitted light, and the polariscope. I know of no objects so easily obtained and mounted which will furnish more entertainment for one's friends than the scales of fishes. Fine mounts of scales can be obtained of Rev. J. D. King, Cottage City, Mass.

Microscopical Characteristics of Oatmeal.

By M. A. DEROS,
PARIS.

[From *Le Micrographe Preparateur.*]

[In a series of articles on "the Adulteration of Alimentary and Industrial Matters," published in recent numbers of this valuable periodical is a good description of the microscopical characteristics of oatmeal.]

In oats we arrive at corn provided with polyhedral granulated starch. This character renders the mixture of oatmeal with other meals very easy to recognize. These adulterations after all are very rare. As starch forms more than 80 p. c. of the total volume of the meal, it is always relatively easy to find some of the suspected granules in the preparations.

The starch grains of oats are often agglomerated and in small ovoid masses, measuring from 50 to 60 microns in their largest diameter. If these agglomerations are examined with care, the starch grains are distinguished very neatly and closely laid against each other, which gives them a polyhedral form. These granules present pretty clear angles. They are irregular and very small, for their diameter varies from 3 to 9 microns; the average being 5 microns. The hilum is not visible and the concentric layers are scarcely distinguishable. The opening generally happens from the exterior to the interior, but here that character is without importance.

In polarized light on a dark field, the oat starch is scarcely visible. In lighting the field, it is impossible to obtain the black cross of which we have spoken *a propos* of wheat. Treated with potash, oatmeal presents a characteristic appearance. The gluten cells, not so large as those of wheat, are arranged in one row only. The albumenoid matter they contain is in very small grains. These cells do not present a blue coloration after treatment with ether.

The fragments of the envelope of the grain contain two important elements, the hairs and the debris of the glumelle. The hairs are very long, slender and almost deprived of lumen. They are easily distinguished by their form from those of wheat; much more easily from those of rye and barley. The glumelle in oats being always joined to the grain, its debris are infallibly found again in the meal.

They are formed of a layer of cells with thick walls, and deeply toothed like a saw. These indentations work into each other. It is this layer which is characteristic. However, similar cells are to be found in barley-meal, perhaps a little smaller and less toothed, but the confusion between these two meals is not possible, the starches being very different.

Under the layer of toothed cells, which forms epidermis, there is another one composed of long bobbin-like fibres. The debris of the glumelles very much depolarizes the light.

The length of cells with toothed edges varies from 145 microns to 230 microns, the width from 13 microns to 21 microns. The long cells are but slightly visible; the tubes and the transverse cells are not distinguishable. After all, what characterizes oatmeal under the microscope is: first, the form of the grains of its starch, their frequent agglomeration in ovoidal masses and their neutrality toward polarized light; then the form of the long and slender hairs and the presence of cogged cells arising from the epidermis of the glumelles.—R. SAMSON.

The Penetration of Microbes into the Blood.—M. Nocard reported, at a recent meeting of the Society of Biology, Paris (*La Press Medicale*), experiments by which he has been able to demonstrate that microbes are capable of entering the blood through the alimentary canal. (He found that, while the blood is usually sterile after an ordinary meal, after a meal containing a considerable quantity of fat, microbes were found very abundant.) His theory is that microbes are conveyed into blood by the small fat globules which are taken up by the lacteals.

Silvering Mirrors.

By HOMO,
DES MOINES, IOWA.

To the physician, in diagnosing disease, to the dentist at his work and to the microscopist, the mirror is absolutely indispensable. The silvering of the mirrors used often becomes damaged and it would then be a great convenience to the user if he were to possess some simple process whereby he could do the work himself. Many times the microscopist would like to make use of devices that are suggested to him by the work at hand, but is deterred from so doing because of inability to procure material from which to construct them without too much expense. In this work the mirror is often no unimportant part, and to be able to obtain it would be to overcome the greater part of the difficulty. The formulas given below will enable a person so desiring, if he has the suitable glass, to do this class of work easily and perfectly. And if he calls the optician to his aid for the glass, the cost will be found very light. In this article reference is made especially to small mirrors adapted for such use. There seems to be no lack of formulas for doing this work, but most of them have proved in the writer's hands very unsatisfactory and some of no use at all.

The formulas given below have been used for over two years. In recommending them, every attention is given to the details that are necessary in order by their use to do the work. The solutions are simple and easily made and the chemicals such as are usually found in every drug store.

In order to do nice work it is absolutely necessary that the glass to be silvered should be perfectly clean. This being the case, consider first the preparation of the glass. Mirror glass is very soft and there is great danger of scratching. Use no alkalies in cleaning and do

not attempt to scratch the old plate off but drop the mirror into a vessel containing some tumeric nitric acid and allow it to remain until the silvering is loose; then rinse the glass thoroughly and clean with prepared chalk, using a clean cloth or Japanese paper. Do not allow the fingers to touch the side which is to be silvered after cleaning and do not use the breath in cleaning. Then cover the glass with alcohol and allow it to stand until ready to plate. When the solutions are ready, remove the glass from the alcohol, place it in a suitable sized dish of porcelain or glass, with the side that is to be silvered uppermost. Then mix equal parts of No. 1 and No. 2, and pour gently over the glass until it is covered. Allow it to remain in this solution for an hour; then pour off the solution and remove the glass, being careful not to touch the plated surface; rinse thoroughly with water and dip quickly into a mixture of solution No. 3 1 part; and water 16 parts.

Remove quickly and rinse thoroughly by dipping it in water repeatedly. All parts of the glass will be covered with the silver, but the face can be easily cleaned by means of a soft cloth; after this is done, examine the plate, and, if it is perfect, cover the silvering with a coating of asphaltum varnish by pouring a little on same and then flowing it over the surface in the same manner that photograph negatives are varnished. When dry, the glass can be cleaned thoroughly and the mirror is done. With care in cleaning the glass and preparing solutions, failure is impossible. The solutions used and mentioned above are made as follows:

SOLUTION No. 1.

Cryst. nitrate silver,	200 grains.
Distilled water,	6 oz.
Aqua ammonia,	q. s.

Place the silver in a pint (clean) bottle, add water and dissolve. Then add ammonia gradually until the brown

precipitate at first thrown down is just dissolved, no more. Be very careful in adding ammonia so as not to add too much; but in order to guard against an excess of ammonia, add a crystal of nitrate of silver and shake; if the solution becomes turbid it is all right; but if it clears up, more silver should be added until it remains permanently turbid. Then filter solution through a double paper filter, pouring back until it comes through clear; add distilled water through filter to make 12 oz.; place in clean bottle and add 1 oz. alcohol. Shake thoroughly and cork, place in cool dark place for 5 or 6 hours.

SOLUTION NO. 2.

Nitrate silver,	16 grains.
Rochelle salts,	12 grains.
Distilled water,	12 oz.
Alcohol,	1 oz.

Place the salts and 8 oz. water in a clean porcelain or porcelain lined evaporating dish, place over heat and raise to gentle boil. When boiling add the silver previously dissolved in 1 oz. distilled water and stir with clean glass rod. Continue to boil gently until solution, which usually turns brown then black, turns gray; then continue to boil for a minute or two more; add balance of water and filter through paper; make up to 12 ounces with distilled water and add alcohol. Place in clean bottle, cork tightly and keep for five or six hours in cool dark place.

SOLUTION NO. 3.

Cyanide mercury,	16 grains.
Cyanide potash,	8 grains.
Water,	2 oz.
Mix. Fiat sol.,	

This solution is used only for amalgamating purposes and is very poisonous. It has no part in silvering but by displacing a certain portion of the silver with mercury forms an amalgam that is lighter and more adherent to glass then the silver itself. This it does instantly

and if not quickly dipped and as quickly rinsed may ruin the plate. With ordinary care there is no danger of this. When the glass is removed from alcohol to plate do not dry it or allow to become dry, but cover immediately with the wax solutions. Do not allow the solutions to stand after mixing but use immediately.

While the solutions recommended will work equally as satisfactory on larger glass, the process of applying them must be modified.

Do Flies Have Teeth?

By THOS. J. BRAY,
WARREN, OHIO.

If any one had asked me this question two weeks ago, I should have replied, "I believe not." Last week, being in Minneapolis, I spent all my spare time in the company of Messrs. H. G. Carter and John Walker, two enthusiastic amatuer microscopists. There I saw several new contrivances pertaining to microscopic technique that interested me very much. Mr. Carter has a clever way of making indestructible cell rings, also a very fine transparent amber cement, which is elastic, hence very suitable for ringing mounts. He has recently devised a novel way of preparing the tongues of flies for mounting and an ingenious little instrument by which they are manipulated in the preparation. Mr. Walker has devised an animalcule trap or catcher, which is very simple and effective and can be carried in the coat pocket.

These gentlemen have been giving special study to the mouth parts of flies and they exhibited several slides of this kind which showed very plainly the teeth, of which there are three rows, the back row being the longer and the front row the shorter. Each tooth is "serrated" or notched out on the point with a V shaped notch.

To see the teeth, take a clear mount of the tongue of a

blowfly and examine carefully at the base of the spiral tubes, and between them will be found the teeth; focus on the front one, then on the middle one, and lastly on the back or lower one. This will give a good idea of the several rows, as well as the individual teeth. In conclusion I will now say, in answer to the query: Do flies have teeth?—"Yes, I think they have."

Disinfecting with Sulphate of Copper.

By M. H. VINCENT,

ALGIERS.

The best agent for disinfection of excrements and of the contents of cesspools is sulphate of copper, especially if care has been taken to reinforce its activity by means of a quantity of sulphuric acid equal to 10 per cent of the excrements. Under these conditions the following results are obtained:

1. For normal stools, putrefied or not, mixed with urine and at an average temperature of 16°C., disinfection is obtained in twenty-four hours, if a proportion of sulphate of copper equal to 6 grams for 1000 c.c., or 6 kilograms per cubic meter is used.

2. For disinfection of typhoid stools and the destruction of Elberth bacillus, the proportion of sulphate of copper is no more, in the same conditions of temperature, than 5 grams for 1000 c.c., or 5 kilograms by cubic meter of excrements.

3. Three grams, 50 centigrams, only of the same disinfectant are sufficient to neutralize 1000 c.c. of matters containing cholera bacillus.

In the two last cases, disinfection is obtained after a twelve hours' contact of the matter with the antiseptic. —Translated by Rene Samson.

Catalogues of W. & H. Seibert are supplied by Fr. J. Emmerich, Sr., No. 74 Murray St., New York, N. Y. O. E. S.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Dr. Thomas Taylor has, since 1871, been at the head of the Division of Microscopy of the Agricultural Department. Gradually divisions engaged in other work have managed to control their own details, have acquired their own microscopical outfits, and left little for Dr. Taylor to do. The money available for his use has diminished, the amount last year being $7.500. Secretary Morton not being forced by political sympathy with Dr. Taylor to further maintain his work has felt free to do what he regarded as for the general good, and says in explanation that during the past year five other divisions have done more microscopical work than this, which is doubtless true. We feel sorry to see Dr. Taylor's work broken up but cannot blame anyone for the occurrence.

This is one of the many indications that microscopy as such is not to survive permanently. The use of the microscope like that of other machines is to become subordinate It is a means and not an end. Likewise microscopical societies will succumb before the biological, medical, and other societies whose members use the instrument as a means to certain ends. Strictly microscopical periodicals will likewise die out. This is why for six years past we have allied the JOURNAL with biology and medicine as being two of the principal fields in which the apparatus may be profitably employed.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

Projection and Measurement.—The microscope may be used as a magic lantern for projecting pictures upon the wall. To accomplish this, place a sheet upon the wall to receive the picture. Put the microscope in a horizontal position. A lamp like the Acme with shade and bull's-eye will best effect the object; in the absence of such a lamp, smoke the inside of a lamp chimney and make a small vertical slit to permit the passage of a pencil of light. A bull's-eye should be interposed between the scope and the lamp with this blackened chimney.

Darken the room and objects may thus be easily projected upon this suspended sheet. Some objects will be much more brilliant than others.

A little practice will determine the best distance for placing the microscope from the sheet. In a similar manner, as stated in Carpenter's Seventh Edition by Dallinger, "the simplest mode of measuring minute objects is to project the magnified image of the object, then carefully trace an outline of the image and without disturbing any of the arrangements, remove the object from the stage and replace it with a stage-micrometer.

Trace now the projected image of this upon the same paper, and the means are at once before us for making a comparison between the object and a known scale both being magnified to the same extent." The same result may be more conveniently effected by projecting the image of the object and micrometer scale upon the ground glass plate of a photographic camera. Any sort of camera will suffice if left tight.

This latter method is described on page 233 of Carpenter and is there said "to make the most accurate measurement of which the microscope is capable."

The same results and the same projection of images may be produced with the camera-lucida.

Mounting Diatoms.—Upon a clean cover-glass, previously placed upon a bronze or iron table, are dropped from a pipette several drops of distilled water. Then from the bottle in which

the diatoms are preserved in spirit, is removed a small quantity of the fluid, with the same pipette. Of this fluid one drop is let fall into the distilled water on the cover-glass. Owing to the alcoholic fluid falling into water, the diatoms are scattered all over the cover glass. The metal table is then gently heated, so that the water evaporates very slowly and without ebullition. The rest of the manipulation is performed in the usual manner.

Adulteration of Flour.—Wheat flour may be examined by adding a little water and then a few drops of a solution of potash (one part of liquor potassæ to three of water). Granules of potato starch are swelled by this means to three or four times their natural size, while those of wheat starch are scarcely affected. Comparisons of different kinds of starch under the microscope would guide in many other investigations.

Seeds.—The markings or reticulations on various kinds of seed render them frequent objects for observation, with the microscope.

Many of them are especially attractive when viewed with a binocular microscope. Adulterations may be detected as well as imperfect seeds in a sample—a subject of much importance to a practical farmer.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

What procedure is necessary to become a member of the Royal Microscopical Society?—J. E. H.

Send your application to Mr. W. H. Brown, Assistant Secretary, Royal Microscopical Society, No. 20 Hanover Square, W., London, England. You must send recommendations on personal acquaintance, from two fellows of the Society. Names of American fellows can mostly be found in the list of members of the American Microscopical Society, marked F. R. M. S., in the Proceedings. Regular dues are £2 2 s., of which foreign fellows (as here) pay three-fourths.

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FOR SALE.—Crouch Intermediate binocular, circular glass stage, mechanical centering on substage, four eye pieces, achromatic condenser polarizing attachment, stops for dark ground and oblique illumination, parabaloid, two solid eye pieces made by Spencer. All in perfect order and have been used very little. $100. GEO. A. BATES, Auburndale, Mass.

FOR SALE.—Barbadoes Earth, containing many rare forms of Radiolaria. Send 40 cents, stamps, for inch cube of this material to
S. S. DAY, 23 Olyphant St., Morristown, N. J.

THE MICROSCOPE.

SEPTEMBER, 1895.

NUMBER 33. NEW SERIES.

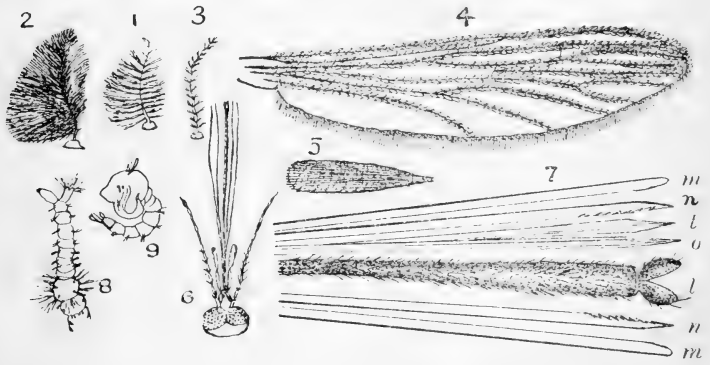
Objects Seen Under the Microscope.

By CHRYSANTHEMUM.

XXVI.—THE MOSQUITO.

This little insect, which is so troublesome on a summer's evening, is very beautiful when seen under the microscope. It should be studied with both low and high powers, also with reflected and transmitted light.

It belongs to the class Diptera, family Culicidæ. It has a long slender abdomen, narrow wings; a long, slen-



der, but firm labium or proboscis; and, in the male, a plumed antennæ.

There are several insects that resemble the mosquito which belong to the midges; one of these comes in the early spring. It has a beautiful plumed antenna, but it can easily be distinguished from the male mosquito by examining the antennæ. In the true mosquito the antenna has fourteen joints and these joints are surrounded by a whorl of long hairs (fig. 1), while in the midge the

hairs are distributed the whole length of the antennæ (fig. 2). The antenna of the female mosquito is long and clender, having fourteen joints and covered with curved hairs so short that it requires a glass to see them (fig. 3).

The wings are of much interest; notice the arrangement of the veins; it is by this arrangement that many insects are classified. One of the most marked peculiarities of the mosquito is the fringe of hairs around the outer edge of the wing, also the scales along the upper edge of this fringe and on the veins (fig. 4). With a magnification of 150 diameters examine the wing by transmitted light; notice the scales, long and slender, and with a ribbed surface. These ribs extend beyond the surface at the larger end, forming little points (fig. 5).

Let us place the head of a female in a compressorium and examine it. It consists of a hemisphere nearly covered by two compound eyes. These, with reflected light, look like black velvet globes set with rows of gold buttons. On the space between them are placed the two antennæ. Between these projects the labium, and at its base the two palpi of three joints each (fig. 6). The labium of the male is provided with an instrument for extracting the sweets from flowers on which he feeds. He never bites. But with the female it is different. It is she who thirsts for blood and her labium is provided with the surgical instruments for obtaining it.

Now, by a gradual pressure bring the plates of the compressorium closely together and use a high power and transmitted light. We see that the nut-like tip of the labium expands into two concave leaves (fig. 7 b). The outside of these leaves are covered with minute papillæ. This is probably a very sensitive organ of touch. The whole length of the labium is covered with scales and with curved hairs. From a groove along the upper side of the labium should come several filaments (but it is difficult to obtain the desired result on account

of the minuteness and delicacy of the parts). These, we are told, consist of two mandibles, which are narrow blades with a stronger back like a scythe; their tip is brought to a most acute point and the edge in immediate proximity to this is cut into about nine teeth pointing backward; the rest is smooth (fig. 2, n). Next come two maxillæ or lower jaws, having filaments as long as the former but still more delicate, consisting of simple cutting lancets with a back and keen blade (fig. 7, m). Besides these there is the tongue, consisting of a central rod which is distinctly tubular with a thin blade on each side, fine edged and drawn to an acute point (fig. 7, t). There is also the labrum or upper lip. This is an imperfect tube which serves as a sheath for the tongue (fig. 7, o). The labium is about one-sixth of an inch in length. The insect inserts the lancets into the flesh to their full length, the labium being folded back, then through a tube in the tongue it is supposed that a poisonous fluid is injected into the wound to dilute the blood and that the blood is then sucked up through this same tube.

The life history of this insect is interesting. When the female is about to deposit her eggs she selects some floating stick or straw and places her front legs upon it; she then allows the middle pair to rest upon the surface of the water and crosses the hind pair over them to look like the letter X. She then deposits a spindle-shaped egg in an upright position in the angle of the X, and another by the side of it, gluing them together with a cement which is not affected by water. This is continued until a mass much the shape of our life boat is formed. In a few days the larvæ hatch and escape from the lower end into the water. The larvæ (fig. 8) are the well-known "wigglers," having a long segmented abdomen, the next to the last joint of which bears a breathing tube. The insect, when at rest, hangs head

downward with this tube resting on the surface of the water, held in position by many plate-like lobes which are at the end of the tube.

This larvæ grows rapidly, and, after changing its skin several times, comes to the pupa state (fig. 9). The change here is complete. The breathing tubes are now in the thorax and at the extremity of the body is a pair of leaf-like bodies with which it swims. This state lasts only a few days when the pupa skin slits down the back and the mosquito comes forth, stands a few moments on the old skin until its wings are dry; then flies away. The larvæ of the mosquito are beneficial as scavengers, for they feed on decaying matter in water.

Structure of our Hemlock Barks.*

By EDSON S. BASTIN.

Only five species of the genus *Tsuga* are known; two of these belong to Eastern Asia, one, *Tsuga Canadensis*, Carriere, is the common hemlock spruce of the Eastern United States; and the other two, *Tsuga Mertensiana*, Carriere, and *Tsuga Pattoniana*, Brewer and Watson, are natives of the Pacific Coast of North America. All are trees of large size and graceful habit, and the first four are very closely allied, being so similar in appearance that they are with difficulty distinguished, while the fifth, *Tsuga Pattoniana*, is somewhat aberrant in its character, approaching more closely the pines and spruces in its structure.

Tsuga Canadensis is an abundant species in many portions of the Eastern United States and Canada, ranging in its habitat from Nova Scotia to Delaware on the east, extending southward along the Alleghanies to Alabama, and westward along the northern ranges of States and

*For this article and the illustrations we are indebted to the kindness of Mr. H. Trimble, Editor of the American Journal of Pharmacy.

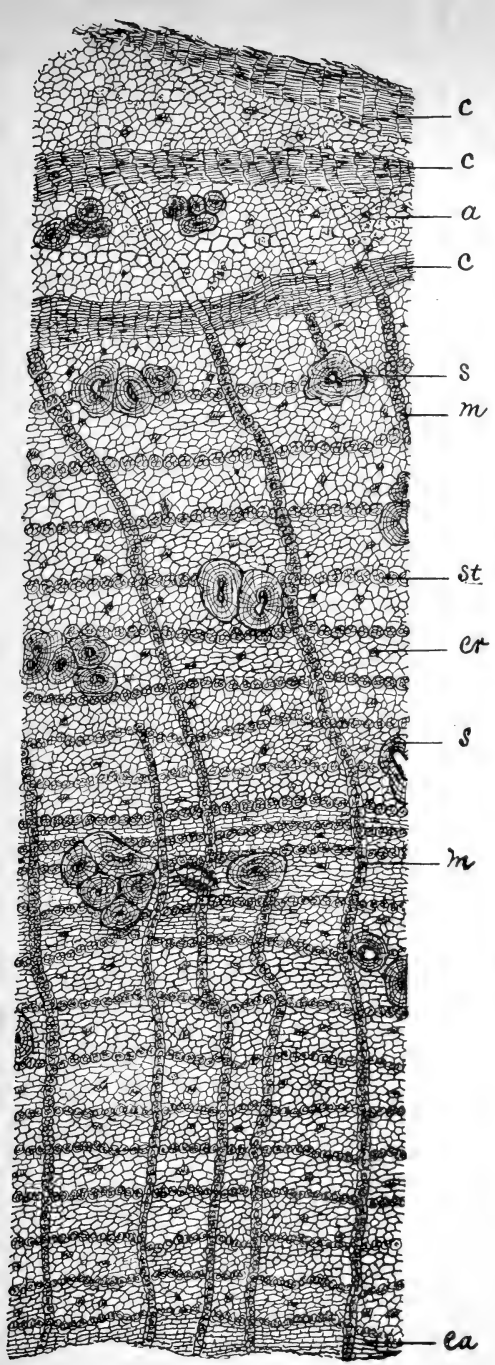


FIG. 1.

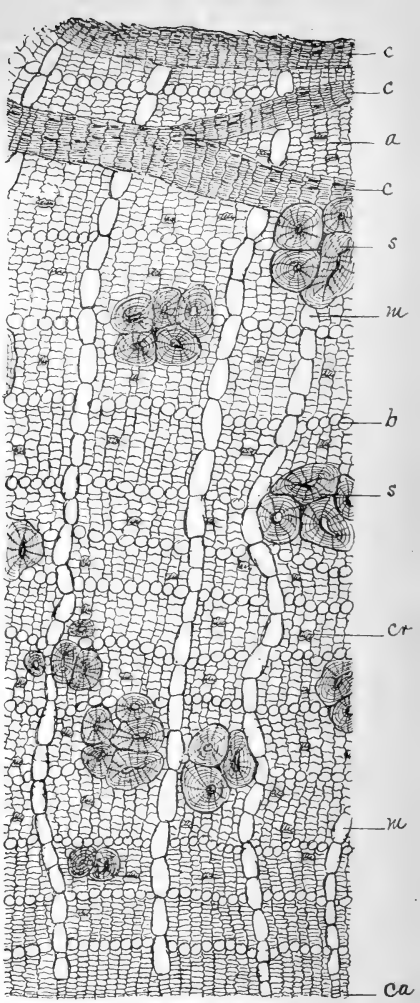


FIG. 4.

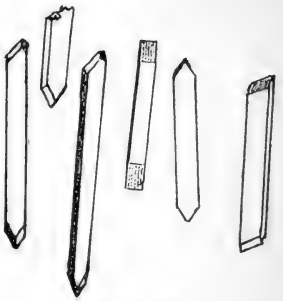


FIG. 3.

the Canadian border to Minnesota. It is easily distinguished from the coniferous trees with which it is associated, by its small cones, one-half or two-thirds of an inch long, pendulous at the ends of the branches; by the slender, spreading branchlets which have crowded apparently two-ranked leaves along their sides; and by the distinctly petiolate, flattened, linear, denticulate leaves, which are green above and glaucous beneath, and provided with a single resin duct on their dorsal surface. Its trunk is extensively employed for lumber and its bark for tanning purposes. Its pitch, also, which is extracted from the old bark by boiling, is employed in medicine for the same purpose as Burgundy pitch. *Tsuga Mertensiana* occurs on the Pacific Coast from the vicinity of San Francisco northward to Alaska. While very similar in appearance to our Eastern species, it is, when fully developed, a tree of much larger size, sometimes attaining a height of 200 feet. It is also straighter-grained, and has a redder and usually thicker bark; but the most distinctive difference, perhaps, is in the fruits and seeds, the scales of the cones being more elongated and the wings of the seeds being relatively longer and straighter. The wood and bark, like those of our Eastern species, are used for lumber and tanning purposes, respectively, but whether or not any commercial use is made of the pitch certainly obtainable from the bark, the writer is not informed.

The barks of these two species are the only ones the writer has examined microscopically. The barks show, as might have been expected, a great similarlty in structure, though there appear to be some characters which we may rely on for distinguishing them. In both, cork formation begins early, and in all cases where the bark has been taken from stems more than a few inches in diameter, the secondary cork-formations have invaded the inner layer of the bark, and bands of cork will be ob-

served crossing at various angles the medullary rays. The cork in both is colored a deep purple, and this coloring matter is bleached out only with difficulty, even by Labarraque's solution. This coloring matter appears to differ in composition from the reddish-brown color-

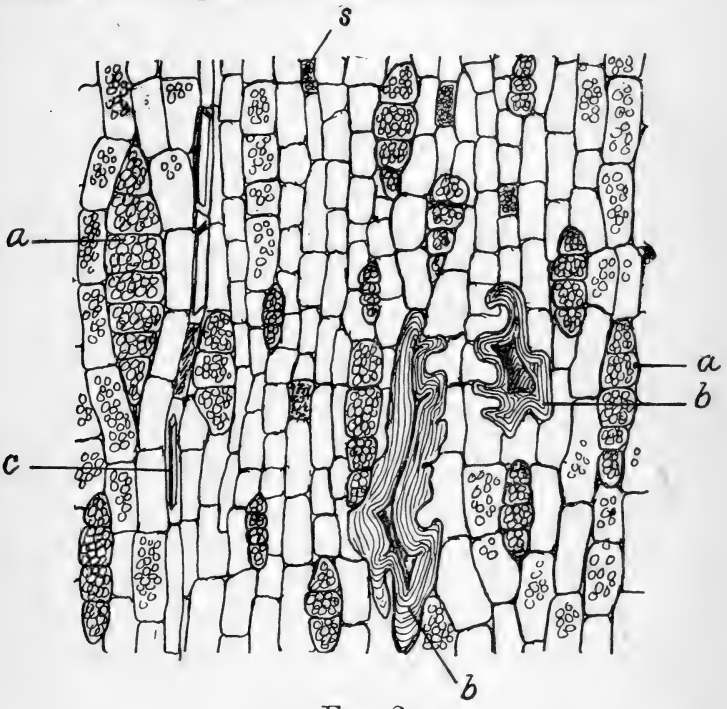


FIG. 2.

ing matter found in the tissues between the bands of cork, for not only is the color a different shade of red, but it bleaches more readily. Tests for tannin show that in both species, also, the white or colorless younger portions of the bark contain little of it, while the older portions, particularly the dead sieve and parenchyma tissues between the bands of secondary cork, are exceedingly rich in it. Stone cells of large size and often quite irregular shape occur, either isolated or clustered in groups of several or many, throughout all except the

youngest portions of the inner bark. They are quite numerous, but are distributed without apparent order. They are marked with numerous very fine pore-canals, and very numerous and fine concentric lines. Abundance of starch was found in the bark of *Tsuga Canadensis*. The medullary ray cells and the tangential rows of large

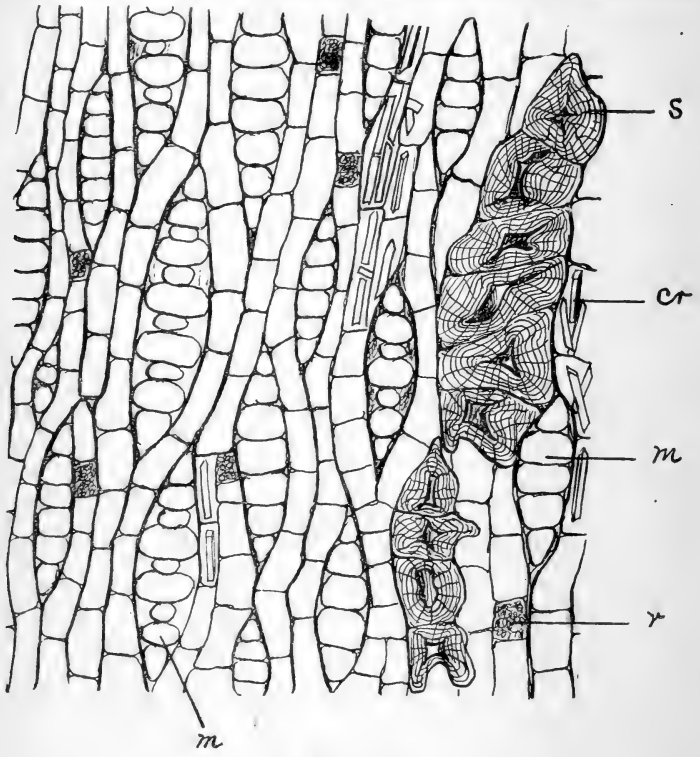


FIG. 5.

parenchyma cells, which occur at frequent and regular intervals in the inner bark, were found to be especially rich in it; but, strange to say, no starch was observable in the bark of *Tsuga Mertensiana*, although there were a similar structure and arrangement of medullary ray-cells and there were the tangential rows of large parenchyma cells, the same as in the other species. The very

close structural resemblance of the barks, and the very intimate relationship of the two species in habit as well as in structure, suggest that the presence of starch in the one and its absence in the other was only a seasonal difference. But this is a point which requires further investigation. The medullary rays in both barks are composed of single rows of cells, and these are radially elongated and of large size as compared with those of adjacent tissues; but those of *Tsuga Mertensiana* are, on the average, larger, and the rays in this species, as seen in a longitudinal-tangential section are composed, on the average, of a larger number of cells. These differences in the medullary rays are perhaps the most constant ones between the two barks.

Both barks contain abundance of crystals of oxalate of calcium. These are mostly in the form of long prisms, and are contained in rows of elongated cells of narrow diameter, which traverse the bark in the direction of its length. The crystals are frequently associated in the containing cells with resinous and coloring matters. In form and arrangement they do not differ in the two barks, but appear to be rather more abundant in the Pacific Coast species.

Oleo-resin cells appear to be about equally abundant in the two species. Those that do not also contain crystals are isolated or in rows of two or three, and the cells are shorter and broader than the crystal cells, though they are not usually so large as the parenchyma cells with which they are associated. They are scattered without apparent order through the inner bark. Besides the oleo-resin cells proper, just described, oleo-resin occurs in many cells not especially devoted to secretions. This is particularly true of the cells in the older portions of the bark.

DESCRIPTION OF FIGURES.

Fig. 1.—Small portion of cross-section of bark of *Tsuga Canadensis*, magnified about 50 diameters. *c*, *c*, *c*, secondary cork formation; *a*, dead phloem

tissues rich in coloring, resin and tannic matters; *s*, *s*, stone cells; *m*, *m*, medullary rays; *cr*, crystal cell; *ca*, cambium.

Fig. 2.—Small portion of longitudinal-tangential section of the inner bark of *Tsuga Canadensis*, magnified about 75 diameters. *a*, *a*, medullary rays, the cells containing much starch; *b*, *b*, stone cells; *c*, row of cells containing crystals of calcium oxalate; *s*, cell containing oleo-resinous secretion.

Fig. 3.—A few of the crystals magnified 230 diameters.

Fig. 4.—Small portion of cross-section of bark of *Tsuga Mertensiana*, magnified about 50 diameters. *c*, *c*, *c*, bands of secondary cork; *a*, intervening dead tissues composed of sieve and parenchymatous elements, and like the other species, rich in tannic, resinous and coloring matters; *s*, *s*, groups of stone cells; *m*, *m*, relatively large, fusiform medullary-ray cells; *b*, band of large parenchymatous cells; *cr*, crystal cell; *ca*, cambium cells.

Fig. 5.—Small portion of longitudinal-tangential section of bark of *Tsuga Mertensiana*, magnified about 75 diameters. *s*, cluster of stone cells; *cr*, crystals of calcium oxalate; *m*, *m*, medullary rays; *r*, oleo-resin cell.

A Comparison of American and Foreign Microscopes.

By C. H. EVANS, M. D.,

CANTON, OHIO.

I have used the microscope for 25 years, have had American and Foreign, (French, English and German). The cheap French instruments are a delusion and a fraud. The stands made by Bausch and Lomb are very good and so are Zentmayer's. Some years ago I bought a Bullock's Professional but did not like it for high power work. The stage rotation was not as true and steady as I expected to find, and the fine adjustment of all the American stands moves too rapidly for high powers. I saw the advertisement in the MICROSCOPICAL JOURNAL of W. Watson & Sons, London, with a discription of their Van Heurich stand and was satisfied that if it was what was claimed for it, it was the best stand in the market at any price. So I ordered one. It cost me $135 with a 40 per cent duty added. I have been using it about six months and I can say after an extended trial that I find it as near perfection as it is possible to get. It is really a beautiful stand and I believe is cheap at the price. I am a believer in protection to American industries and

home manufacture but yet I believe in getting the best in everything microscopical and I can say that Watson's stand (the Van Heurich pattern) is the finest piece of workmanship both in design and finish that I have ever seen or used and I do not hesitate to recommend it for any one that can pay the price.

I have three stands and often I use all three one after another to save time in changing objectives. My microscopical outfit will invoice over eight hundred dollars net.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

How to Examine Objects with the Microscope.—Many amateurs defeat their own purposes by attempting to examine too much of a substance at one time. Thin sections and small portions of objects to be examined should be placed under the microscope. The microscope, as the name implies, is an instrument for the examination of small things. Generally a very small particle of the substance to be viewed will answer far better than a large amount. A particle as big as a pin's head is usually sufficient. In examining blood such a quantity is a plenty; but a drop as big as indicated is too large until it is spread out. Place the drop to the left of the center of a glass slip; take another slip with a true edge; with the latter press firmly and draw to the right so that but a thin film is left on the first slip of glass, cover immediately with a thin glass and examine with a fifth or quarter objective and the corpuscles will be nicely displayed. In the case of starch or spicules use but a small drop and examine under a cover and much more will be seen and made more beautiful than if a large or thick mass were attempted to be examined.

So with butter, a drop as above mentioned placed on a slide, covered and pressed with the finger into a film, will under a quarter objective instantly show the natural crystals. The rule here stated is a good one to become accustomed to and exper-

ience will demonstrate that too little will be more satisfactory than too much.

Oscillatoria.—These plants are very beautiful objects for the microscope. They are frequently found free in water. Often they form a thick green scum on the surface of stagnant water and this scum when gathered will form a thick mat. Having a piece of this mat to examine, with the forceps pinch off a piece as big as a pin's head; transfer to a glass slip; cover with a drop of water tease out with needles, cover and examine and a beautiful object will be presented. They are composed of fine microscopic threads containing a blue-green endochrome which is sometimes replaced with red or violet. Many genera are enclosed in a hyalene gelatinous sheath. Their motions, whence their name are derived, is interesting.

Needle Holders. There is nothing nicer for dissecting needles that the crochet needle holders which may be procured from any store that deals in fancy goods. Common needles of any suitable size may be inserted and when the needles are broken or useless, new ones may be quickly inserted. These holders are inexpensive and will last a life time, while needles permanently mounted in handles when broken render the entire tool useless.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

230. *What are the best books with which to identify microscopic forms which are found in aquaria and ponds?*

The best books are Kent's Manual of the Infusoria and Hudson's Rotifera or Wheel-Animalcules.

231. *Where can I get information as to the best methods for pressing and mounting plant specimens and the best sort of a show case for exhibiting them?—L. Stevenson.*

Gray's Lessons and Manual of Botany. Encyclopædic Britanniac—article: Herbarium. Botanical Gazette, Vol. XI, No. (June 6, 1886), Herbarium number.

All contain directions for preparing plant specimens. The specimens, mounted on cardboard, are usually kept in tight drawers or on shelves tightly inclosed to keep out dust and insects.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

RECENT PUBLICATIONS.

Chiero's Language of the Hand. A complete practical work on the sciences of chieromancy and cheirognomy, containing the system, rules and experience of Chiero the Palmist. The Transatlantic Publishing Co., London and New York.

This is an exhaustive and admirably written treatise on the science of Palmistry. It not only contains a complete exposition of this branch of psychological study for the use of the student, but is a valuable work for every thoughtful investigator on the lines of natural physical science. As the author truly says:

> The greatest truth may lie in smallest things,
> The greatest good in what we most despise,
> The greatest light may break from darkest skies,
> The greatest chord from e'en the weakest strings.

Forty full-page plates fully illustrate the subject treated, in addition to over 200 engravings of lines, mounts, marks, etc. Among the former are reproductions of the hands of a number of world-celebrated personages, which make an interesting comparative study, including those of Sarah Bernhardt, Mark Twain, "Bob" Ingersoll, Mrs. Annie Besant, Sir John Lubbock, and many others.

The book is the result of exhaustive study and research on the part of the author in all parts of the world, and is probably the most elaborately written work on the subject yet published.

It carries to the reader the intense earnestness and belief with which the author is evidently inspired.

Systematic Study of the Organic Coloring Matters by Drs. G. Schultz and P. Julius, translated and edited by A. G. Green, F. I. C., F. C. S. London: Macmillan & Co. $5.00.

This is a valuable work primarily intended for the use of those interested in the coal-tar color industry and the users of its products. Here are set forth in detail all the various bodies: hydro-carbons, phenols, bases, etc., contained in coal-tar, together with the intermediate products and coloring matters. Under the latter heading will be found a series of admirably arranged tables containing all the information that can possibly be required for the use of the dyer. The commercial name of the product is set forth together with the scientific name, empirical formula, constitutional formula, method of preparation, year of discovery, discoverer, patents, literature, its behaviour with reagents, shade and dyeing properties and method of employment. To the user of coloring matters and to the chemist the work is of great value.

Paul and Virginia.—Bernardin de Saint-Pierre, translated with a biographical and critical introduction by Melville B. Anderson. A. L. McClurg & Co., 117-121 Wabash Avenue, Chicago, Ill. $1.00.

In this story Saint Pierre uses the beauties of nature as seen in tropical seashore and cliffs as a background for a picture of the moral beauty of a little community. The portrayal of human nature and manners is no whit less faithful and vivid than the unrivalled picture of tropical landscape. The development of the two principal characters from childhood to manhood and womanhood is drawn with a fidelity that makes admiration increase with study. This book is worthy to be included among our classics. It has been translated many times but never with so much accuracy and such beauty of language as by Prof. M. B. Anderson of Stanford University. The book contains, besides the story, a fine biography of Saint Pierre and many critical notes, and is well adapted for use in schools. Prof. Anderson has also translated Hugo's "Shakespeare," "George Sand," "Madam de Sevigne," "Thiers," and others.

SCIENCE-GOSSIP.

Audubon Sugar School.—The fourth annual session of the Audubon Sugar School closed on Saturday, June 29th. Since the opening of the school in October, 1891, over sixty students have matriculated, coming from Cuba, Porto Rico, Spain, U. S. Colombia (South America), St. Croix, Hawaiian Islands, and the States of California, Kansas, Nebraska, Illinois, Tennessee,, Georgia, Mississippi and Louisiana. Over one-half of the above number have been from Louisiana.

This school has been established and is being prosecuted solely with the view of benefitting the sugar industry of Louisiana. It, therefore, appeals to the sugar planters of this state for their earnest sympathy and support.

Upon the grounds are conducted a large number of experiments in sugar cane (covering over 100 in different kinds of fertilizers, 50 or more in physiological tests, 30 plats of varieties of cane, including several promising varieties of seedlings and numerous experiments in different modes of cultivation, drainage and irrigation). Besides sugar cane, numerous experiments will be found in corn, sorghum, teosinte, grasses, clovers, alfalfa, and other forage crops, ramie, jutes and hemp garden and fruit crops.

There are three well equipped laboratories:

1. Agricultural, where special investigations of soils (physically and chemically), fertilizers, feed stuffs, coals, bone-black, etc., are made. Mr. J. L. Beeson, a Ph. D., of Johns Hopkins University, has charge of this laboratory.

2. Organic and Sugar Laboratory, where the physiological and organic properties of the sugar cane and kindred plants are studied, and where sugar chemistry in all of its branches is carefully taught. Mr. L. W. Wilkinson, M. S., a graduate of the University of Heidelberg, directs the work in this laboratory.

3. Station Laboratory, where analyses of all kinds are made for the public good. Mr. R. L. Bivins, M., S., a graduate of the Alabama Polytechnic Institute. has charge of this laboratory.

In the Department of Mechanical Engineering there is, besides a fully-equipped sugar house, a drawing room with every facility for excellent work, furnished with handsome drawings and illustrations of the various sugar machinery made by the leading manufacturers of the world. Mr. R. T. Burwell, M. E., of Cornell University, has charge of this department. Wm. C. Stubbs is director.

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FOR SALE.—Crouch Intermediate binocular, circular glass stage, mechanical centering on substage, four eye pieces, achromatic condenser polarizing attachment, stops for dark ground and oblique illumination, parabaloid, two solid eye pieces made by Spencer. All in perfect order and have been used very little. $100. GEO. A. BATES, Auburndale, Mass.

FOR SALE.—Barbadoes Earth, containing many rare forms of Radiolaria. Send 40 cents, stamps, for inch cube of this material to
S. S. DAY, 23 Olyphant St., Morristown, N. J.

FOR EXCHANGE.—I will exchange my photograph (*carte de visite*) with all American Diatom-friends. Y. C. RINNBOCK, Wien XI-1, Simmeringer Hauptstr, 14 Austria.

THE MICROSCOPE.

OCTOBER, 1895.

NUMBER 34. NEW SERIES.

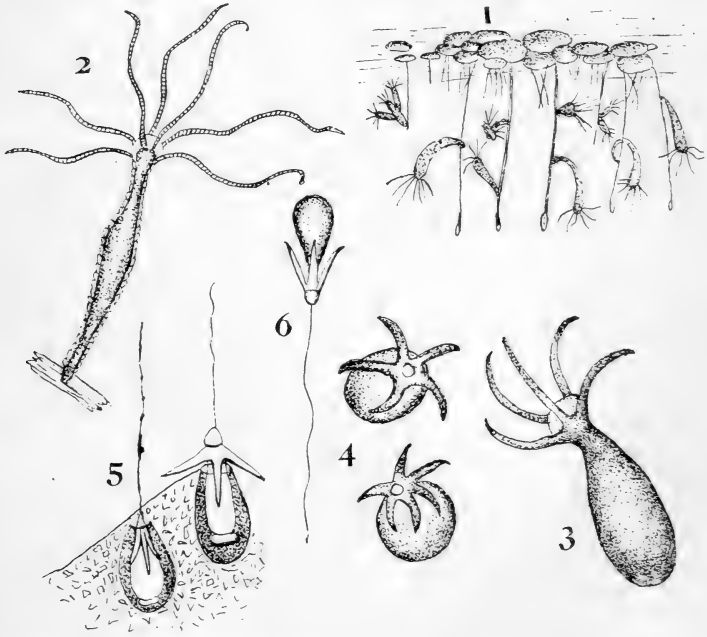
Objects Seen Under the Microscope.

XXVII.—THE FRESH WATER HYDRA.

Tránslated from "Le Micrographe Preparateur."

By CHRYSANTHEMUM.

There are three kinds of fresh water hydra in our country; the green, hydra viridis, which has short arms, their greatest length being about one-half that of the



body; the brown hydra, hydra fusca, which has long arms, they being twenty-five millimetres or more in length; and the gray or common hydra, hydra grisea or vulgaris (fig. 1, 2), whose arms vary in length.

To procure this animal, take in a vessel some duck-weed from a ditch or pond of stagnant water. Put this in a receiving glass and cover the glass with a thick paper, leaving a vertical opening on one side. The next day, take off the covering and look at the under side of the weeds. A large number of white roots will be seen extending into the water. Among these the polyps will be found. They are quite in their element here. Their arms and bodies mingle with the filaments of the roots, which, on account of their resemblance, serve as a means of protection. The hydra hold themselves rigid, head-downward, their arms hanging like a woman's hair (fig 1), in such a way as to be easily mistaken for the roots of the Lemna. As they prefer the light they are found in the most highly lighted part of the receiving jar. The floating leaves are also on this side. Our little contrivance is quite useful, for by it one knows in advance just where to find the polyp.

Take the hydra by breaking off the plant to which they are attached, being careful not to destroy the arms, which are sometimes attached by their free extremities to surrounding objects. These arms (fig. 2), are very extensible and can be contracted or elongated in the same individual. The number of arms is not always six, as it is generally believed, but, unless in case of accident, it is at least six; it may be more, but usually some multiple of six.

The hydra has a foot terminated by a hollow disk, by means of which it can attach itself to bodies in the water as well as to aquatic plants. It is found attached to stones or stakes standing in the water, to bits of wood, or strings and ropes floating in the water, also to fishing nets. The foot is solid and is terminated by a hollow body which is shaped like the finger of a glove, having but a single opening. This cavity acts at the same time as a stomach and an intestine. Its opening is at once

the mouth and the anus of the animal. To this orifice the arms or tentacles are attached. These tentacles are used to catch the anamalcules on which it preys. They are straight but flexible and easily assume a spiral form, for they are very retractile. They roll themselves around the Daphnies, the Nias, and a host of other little animals that live in the water either in a perfect or larval state, for there are without doubt thousands of different kinds of animalcules which inhabit little ponds. When the hydra have swallowed their prey,the body dilates and loses its long form (fig. 3), becoming cylindrical or conical (fig. 4), at the same time the arms contract, making them unrecognisable.

The hydra hunt like a blind person. They do not throw out one of their arms, like a serpent, against the animal which passes; but as a spider spins his web so they send in all directions into the water some fine threads or else fix them, in perfect rigidity, to neighboring objects, much like a snare. When an animalcule touches one of these free or fixed threads it is immediately struck with paralysis and remains adhering to the arm which it has touched. The hydra has sufficient time to surround its captive and draw it into its mouth.

This phenomenon, so strange and unexpected, is due to the fact that the fresh-water hydra contains some internal organs which secrete a special poison. These consist of a spiral thread connecting with a sac of poison. Every one has heard of the Galeres, that paralyse the bathers, in tropical waters, by their tentacles by giving them urticaria or nettle-rash of sufficient violence as sometimes to cause death. It is on this account that the sea anemones have received the name of sea nettles from some fishermen. The corals and madreporaria are more or less provided with these poison sacs; some fresh water zoophites also have them.

If the arms of the hydra are examined with a low

power they are seen to be covered with a series of little points. It is these which contain the poison sacs. They consist of a depression containing a bladder full of liquid haline, in which is plunged a spiral thread terminated at the base by an enlarged trident, the hooks of which turn back (fig. 5, 6). At the least touch, the spring unrolls itself and the filamant, impregnated with the poison, penetrates the body of the imprudent beast, which thus loses his power of voluntary movement. The three hooks at the end of the sac cannot penetrate into the body of the victim since they are at the base of the thread and not at its extremity (fig. 5), as has been erroneously stated. Besides, if they penetrated at the same time as the needle the animal would lose them because he would not be able to withdraw them. It is true there would still be enough left, for his tentacles are covered with them.

The hydra have many curious peculiarities. They walk like the Geometrid caterpillar, using their mouth as a cupping glass as opposed to that of the foot. They take a step upon the head and draw up the foot to the neck and so continue. They run as a gymnast, who turns a somersault upon his hands to come back upon his feet again on the other side. They have no eyes yet they seek the light the same as plants and infusoria.

They probably feel light as we feel heat. They digest with their skin as with their digestive mucous. This is proved by turning them inside out as we do the finger of a glove. A hydra which has been turned inside out can be made to swallow an ordinary hydra or vice versa, and two hydra can be joined body to body so as to make only one, armed with a double row of tentacles. They can be made to grow again or can be made to grow from a piece.

I. To turn a hydra inside out. There are several ways of doing this. A practical way is to take advant-

age of the peculiarity which these animals have of dilating themselves when they have swallowed a voluminous prey. Give them a bait like those employed by fishermen. This may be the larvæ of the diptera, Chironomus plumose. The hydra dilates itself to swallow. Profiting by this movement, pierce his body from behind toward the front with a thread of stiff silver or a steel wire such as is sometimes found in a box with syringes and used to clear the injecting needle. The hydra struggles and throws itself up suddenly into its normal condition; but try again with patience and at length he will be fatigued. Hold with a pair of forceps the upturned part and the animal will finally allow himself to be turned. At the end of two days, or even less time, the hydra is hungry and commences to eat in his new position, but still trying to return in part to his former position. At first he digests with the part of the stomach which he has drawn inside, but soon he digests completely by the aid of his skin, this having become a digestive mucous. Sometimes he grows together in the position at first taken and continues the live thus, although somewhat shortened in length. Care should be taken in the first few days to keep him in position by a needle, which prevents him from returning to his normal position by pressing from the interior toward the outside to prevent his drawing himself into himself.

The hydra can make a new mouth if for any reason the old one is destroyed. This happens when the estosarc is held against itself. It forms cicatricial shrinking which finally obliterates the exterior orifice. A new mouth then forms underneath the strangulation. The anterior part may dilate itself either wholly or in part, the result of which is a new mouth, lateral in the latter case, terminal in the former.

II. To unite two hydra into one. This operation can be performed in two different ways, either by unit-

ing the skin to the skin or the mucous to the mucous. But one cannot unite the skin of one to the mucous of another, for when a small hydra is swallowed by a large one, the larger one soon rejects it, or if it happens that the small one is retained the large one finally digests it. They cannot be made to grow together.

To unite the hydra, mucous to mucous, turn as the finger of a glove the polype which is to be swallowed, and cause it to be taken by the second one by pressing it into the digestive cavity with a silver wire. The two mucous membranes are then in immediate contact. In a few days the walls of their bodies have grown into one, and it is only a single polyp that digests with what was the skin of the smaller animal, the only difference being that its body is thicker than in the normal state, for it is composed of a double row of tissues and that it has a double row of tentacles.

To make them unite skin to skin, the one which is to swallow the other should be turned inside out and by the aid of a needle pressed one inside the other.

When one attempts to unite the skin to the membrane and holds them (the little one smallowed by the larger one) together with a needle inserted transversly ; it happens that they do not grow together but the exterior hydra allows himself to be torn by the needle the whole length of his body, while the smaller one remains whole but taking the needle with him. The larger one grows together again.

III. To divide a hydra into several. When a hydra is divided into two parts lengthwise, in twenty-four hours the parts will have healed leaving two polyps,each a little smaller around than at first and having one-half the number of tentacles of the original. When a hydra is cut in two transversely it takes two days for one part to form a new foot and the other a new crown of tentacles. When a hydra is cut into three pieces with the

scissors in one week there will be three complete hydra. When a hydra is cut in two transversly and longitudinally, at the end of eight days there will be eight hydra. Several pieces of the same animal can be made to grow together and also pieces of several different animals .

It is quite difficult to perform the preceding experiment by uniting the green with the brown hydra.

Reproduction is produced by budding and by eggs. When the animal is well nourished the food produces little hollow buds which communicate with the digestive cavity of the mother. At the end of two days in summer and six weeks in winter this little bud is detached and becomes a separate animal. The hydra does not usually carry more than five buds at the same time, these being in different stages of development. But in artificial culture with a high temperature and plenty of food more are produced and they remain attached to the mother a longer time. Tremblay had a gray hydra which carried nineteen little ones which belonged to three generations.

The fresh water hydra will not form a new individual from a tentacle, although some salt water species can be made to do so. Sexual generation is produced by fecundated eggs. Toward the last of the summer the foot produces some protuberances which at first resemble buds but instead of producing either a mouth or tentacles they form in their cavity either ovules or spermatozoa. These external organs should be considered as being true individuals charged exclusively with the care of reproduction, as it is often the case with marine polyps.

PERSONAL.

Herbert M. Hill is city chemist of the Department of Health of the city of Buffalo, N. Y.

One of the Questions that Meets the Student of Bacillaraceæ.

By ARTHUR M. EDWARDS, M. D.
NEWARK, N. J.

The finding of "species," as they were called by the older observers, and the naming of them is not the duty of the true student of the Bacillaraceæ. The naming of them is easy enough; if a name cannot be found that suits their peculiarity, a name of some person or place can be substituted. But when we come to give a name which describes their peculiarities is is more difficult. For instance, it is easy to name a little boat-shaped green cell when it is recent and call it Navicula viridis. But when the boat-shaped cell is twice or three times as large it may be called Navicula, or little boat, which is larger, or major. But this is giving a "specific" name to the object and it has not a right to the "specific" name. For it is a sporangium, as it is called, of Navicula viridis. So with other so-called species. The finding out the why and wherefore of things and of their being is the true duty of every naturalist.

Some time ago the question of whether the Diatomacæ or Bacillaraceæ were single or multiple cells came up in the investigations of Dr. Wallich, and he contributed a paper to *Popular Science Review* on the subject. I do not remember what conclusion he came to, but this is what I came to—the Bacillaraceæ or Diatomacæ are multiple cells. Again I am puzzled to meet the question, for there are certain peculiarities that appear as the magnification, if the Bacillaraceæ is made more clear by modern objectives. Again, I am inclined to the multiple side of the question. And for this reason, Pediastrium granulatum, F. T. K., an extremely common Desmid, was examined in Peckman's Brook, N. J., this May. This is a beautiful form, being like a green star.

Along with it was Melosira crenulata, F. T. K., Bacillarian, also very common. This looks like a number of pill boxes, but with the endochrome, or coloring matter, of a fawn tint. There are other Bacillaraceæ also in abundance, but of those I do not wish to speak at the present time. Closterium is a very common Desmid everywhere. It looks like a brilliant green quarter moon and looks as if it were multicelled, or made up of two cells not separated by cellusose, but the contents of the cells are separate for cyclosis, or the movement of the protoplasm, which takes place in two separate whorls, being transformed from the ends towards the center on the outside of the cell; but inside the cell wall, which is made up of extremely delicate hardening matter, it is cellusose most likely. In Pediastrium the cells are made up of cellusose also, but are separately arranged in the form or a star and they are evidently separate cells. In Melosira the cell walls are siliceous and in a chain. As I have said, the Pediastrium and Melosira are evidently multicellar. In Closterium the contents are in one investing membrane, but the cell contents, or endocrome, is divided into two parts. Navicula is also separately celled, or multicellular, although the contents do not move as in Closterium. For there are several anothozoa or male organs at least, which are circular-celled "oil globules" and in the spring are active, and two large "oil globules" which are ova or female organs. From this reason I believe that the Bacillaraceæ are multicellular.

I have recently studied a Bacillarian which is Cymbella lancenlula C. G. E., which is the same as Cocoonema lanceola to C. G. E., and is the sporangium of a small species, perhaps Cymbella cistula H., which is also present in the same gathering (book on Orange mountain, New Jersey), and I see that the C. lanceolata has the cell contents separated into two portions, and at each end on

the frustule, so that this can be said to be multicellular. Perhaps this is the case with other species when they occur as sporangia, but I have not witnessed it as yet.

Farrant's Medium.

By THOS. J. BRAY,
WARREN, OHIO.

The mounting medium known as "Farrant's" is a very viscid mixture of gum arabic, glycerine and camphor water. It is an excellent, ready and suitable medium for mounting vegetable sections, etc., but is not as much used as it ought to be by reason of the persistence with which air bubbles are held in the compound. The question is often asked, "How to remove the bubbles?" My answer is, "Don't let them get in." The reply to this is invariably, "Easier said than done." There is no trick in it, provided certain rules are followed. I may not be able to give your readers the *best* method of doing it, but will give my way of operation, which, if followed closely will avoid the troublesome air bells entirely.

Prepare Cells. These may be Carter's culluloid, which I use, or made of King's cement, gold size or other suitable material spun on the slide. They must be dry and hard, see that the top surface of the cell is *level* and *smooth*, then take a piece of clean wire and put it end foremost into the bottle containing the medium and let it remain there until ready for use; this wire is used as a dropper. When ready lift out the wire and hold it over the cell about a half an inch above it; a drop of *solid* gum solution will soon form at the end and fall off into the cell. Put the wire back into the bottle, take the specimen and place it on the drop in the cell and allow it to fall to the bottom by its own weight if it will do so, if not, then a very gentle pressure will help it. Avoid stirring the mixture in the cell as that will cause

bubbles and the job is spoiled. Next take another dip on the wire and drop it *on* the object in the cell, this will fill an ordinary cell (the amount of liquid carried over, that is the size of the drop, depends on the size of the wire and the depth of the liquid in the bottle) full to the edges and much fuller at the center, as it will take a spherical form; next place a clean cover on the medium *centrally*, and allow it to fall down by its own weight. Should it not do this, then gentle pressure may be used on the center of the cover; be in no hurry, go slow, and when the cover is down fair and square on the cell, put on a spring clip and with a wooden needle holder handle, or some other similar tool, press the edge of the cover down into close contact with the top of the cell.

Clean off by absorbing the superfluous medium with bibulous paper. Take off the clip, place the slide on the turn-table, put a conical rifle bullet on the cover *centrally*, for a weight, then with camel's hair pencil and water, wash all around the cover, *clean*, dry with bibulous paper; then with camel's hair pencil and alcohol, or benzol, brush around the cover, this is to absorb all moisture, then with *hot* paraffine spin a seal ring of paraffine around the juncture of cover and cell and when this is cool and hard, the mount may be finished in the regular way, labelled and placed in the cabinet a "thing of beauty" and a "joy forever."

Interesting Little Aeronants.

By PROF. E. B. KNERR,
ATCHISON, KANS.

The spores of the common horsetail (Equisetum arveuse) are exceedingly interesting little aeronants. If the tip or cone of a ripe fertile frond be struck against a glass slip a shower of white dust will be observed to fall out. Place this just as it is without a cover under a half inch or inch objective and the dust will be seen

to consist of myriads of little spheres, most of them having four radiating arms. Now, while you are observing, breathe very gently over the glass slip, or better have a friend do this for you, and suddenly all the arms will contract about the spheres as if you had breathed into them a very spasm of life. Now watch the spores carefully a few seconds longer and you will see the arms gradually unfold again in quite a comical, cautious way.

The explanation of this peculiar power of the horse-tail spores is not far to seek. The little arms are exceedingly hygroscopic and they expand very promptly to the moisture of the breath. Indeed I was greatly amused one day while observing their antics to see them keep up a slow waving twisting motion as though they were undecided as to whether they should remain expanded or fold about their precious charge. This puzzled me until I observed that the door to my room was open; and as the air outside was more moist than in doors, every little current as it came and went registered its influence on those sensitive little arms.

Each arm may be seen to have a spoon-shaped extremity which enabled the arms to cover the spore completely while yet green. Indeed, they then constituted the outer coat. As the spore ripens, its outer coat splits up into these arms and a dry wind readily detaches it from the spore case, bears it aloft and away until perchance it is wafted over a swampy place when the air is moist. The moisture causes the arms to fold about the bit of concentrated life in their charge, allowing our little aeronant to settle in a congenial place when it may multiply and replenish the earth with horse-tails.

Soluble Glass as a Mounting Medium.—Soluble glass sufficient to cover the specimen is used, the cover-glass is placed in position, and a hard brown varnish applied round the edge to fill up the intervening space under the slip, and so act as a cement to keep the cover-glass firmly fixed.—W. W. McBride.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

RECENT PUBLICATIONS.

Manual for the Study of Insects.—By John Henry Comstock, Professor of Entomology in Cornell University and in Leland Stanford Junior University.

This work has been prepared to meet the need for an elementary, systematic text-book for the use of students in high schools and colleges and of teachers in primary and secondary schools. Its most distinctive feature is a series of analytical keys by means of which the family to which any North American insect belongs can be determined. Under the head of each family the characteristics of the family, both as regards structure and habits are given, and the more common species described. It is thus possible for the student to classify any insect to its family and to learn the habits of the insects of that family, and, in case of the more common species, to learn the name of the insect.

The book is profusely illustrated with figures prepared especially for it. A large proportion of these were engraved from nature by Mrs. Comstock.

Although the book is a large one and gotten up in an expensive style it is sold for a nominal price, the preparation of it having been a work of love rather than a financial venture. It is hoped that its low price, $3.75 net or $4.09 postpaid, will bring it within the reach of all who desire to learn something of insects and their ways.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

Indexing Slides.—It is very uncomfortable to be unable to find a particular slide when desired. To obviate an inconvenience of this kind it is well to number and index the slide, and also to label the boxes containing the slides with the box. A very little trouble in the direction here indicated will place every slide under control of its owner. Without some arrangement it is remarkable how soon a slide will become as a needle in a hay-stack. Little index books may be procured and are inexpensive. It is well to keep boxes with trays for slides in course of preparation. In such cases always write the name of the preparation on a slip of paper and keep it in the tray with the slide until it is permanently mounted.

Erysippei.—These are the powdery mill dews and this is the season for finding them on leaves. They are beautiful and compete favorably with diatoms as microscopic objects. Leaves will be found that look as if full of cobwebs or as if they had been whitewashed;—if they belong to this class, when in full fruit, often with the eye or better with a lower power lens, innumerable little dark dots can be seen scattered through the whitewash or cobwebs on the leaves.

When the leaves are gathered it is well to press them at once.

On arriving at the microscope, with a spatula scrape off a few of the dark dots and transfer to a drop of water on a slide cover and examine with a low power. Then remove the slide, gently press on the cover with the finger and examine with a higher power about a quarter objective. With the low power the dark dots will be seen to be variously marked perichsia. Around the apothecia will be found the appendages by which the genera are classified. Some appendages are simple, some are long sharp spikes, some are shepherd crooks, some are long wth stars at the end. The pressure on the slide will mash the perithecia and expose the asci containing the spores. On the number of spores, specific distinctions are founded.

It it nice, neat, clean work which any miscoscopist with a little patience can accomplish. The U. S. agricultural depart-

ment and many state experiment stations pay a great deal of attention to the Erysippei as they are very destructive to the host of plants on which they quarter themselves. If on the first examination the appendages do not appear, try a new specimen. Often on transferring a specimen to a slip the appendages are broken off or rolled up so that the distinguishing ends cannot be seen.

White Zinc Cement.—Oxide of zinc rubbed up with equal parts of oil of turpentine and eight parts of solution of gum. Dammar in turpentine of a syrupy consistence, or Canada balsam, chloroform and oxide of zinc.

A clean satisfactory way may be effected by purchasing a tube of white zinc from a dealer in supplies. Be sure and obtain white zinc and nothing else; dealers will inform purchasers that flake white or somthing else is just as good. To make a good cell, express a little of the white zinc on a flat hard surface, drop upon it a small amount of pure clear linseed oil; mix with a putty knife; when of proper consistence turn rings upon the turn table, using a very fine pointed painter's pencil. The proper consistence can be gained by experience only. If too thick the rings will not readily turn and if too thin the rings when turned will flow. If made properly, set the slides away until they are hard and dry, then they will be cells that are a comfort to the user. Mix a batch of the zinc whenever you wish to make cells; it does not seem to work well when mixed up and set away for future use.

Brunswick Black is asphalhem dissolved in turpentine. A little India-rubber dissolved in mineral naptha is sometimes added.

Preparation by Teasing.—A minute fragment of tissue should be placed in a drop of fluid on a slide, and torn or unravelled by two sharp needles. This is accomplished more easily after maceration, and sometimes it is necessary to macerate in a substance which will dissolve the connecting material. This picking or teasing should be slowly and accurately performed. Beginners often fail of a good preparation by ceasing too soon, as well as by having too large a specimen. The most delicate manipulation is required to isolate nerve cells and processes.

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S. S. DAY, 23 Olyphant St., Morristown, N. J.

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THE MICROSCOPE.

NOVEMBER, 1895.

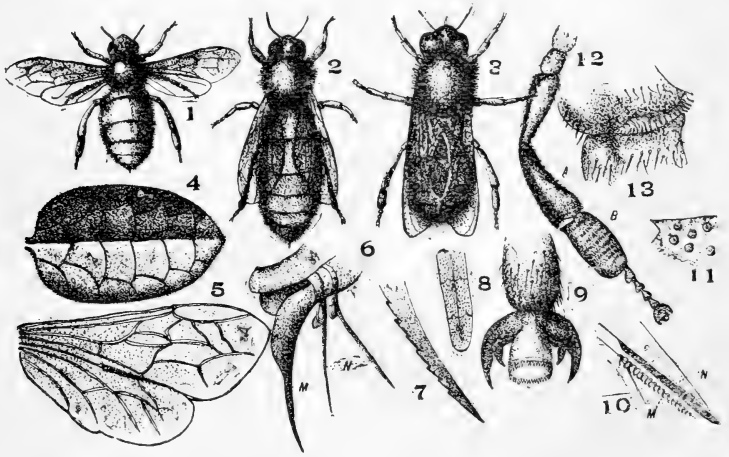
NUMBER 35. NEW SERIES.

Objects Seen Under the Microscope.

By CHRYSANTHEMUM.

XXXVIII.—THE HONEY-BEE.

Much has been said of the wonderful skill displayed by the honey-bee in performing its domestic duties, but this skill is not more wonderful than is the bee itself when seen under the microscope. Of the Apis millifica or honey-bee there are three kinds in the hive: the males or drones, the female or queen and the neuters or worker-bees. The head of the worker-bee (fig. 1) closely re-



sembles that of the queen (fig. 2), while in the drone (fig. 3) the head is much larger, and the eyes are oval in shape and meet on the top of the head. The thorax of the queen is larger and more oval than that of the worker, while in the drone it is shield-shaped. But the

abdomen is the part which in the three types presents the greatest dissimilarity. In the worker it is small and oval, in the queen it is much longer and thicker, tapering to a point, while in the drone it is short, stout and oblong, having the posterior part fringed with long stiff hairs.

Examine the head with reflected light and a low power. There will be seen two compound eyes. Attached between these are two antennæ and at the front is the mouth. If a few of the hairs are removed from the back of the head, three simple eyes may also be seen (fig. 14, a).

The eyes.—The two compound eyes consist of thirty-two hundred single ocelli, each of which is composed of two remarkably formed lenses: the outer or corneal (fig. 16, a), and the inner or conical (fig. 16, b). The cornea is easily pealed off and the grouping of the lenses becomes distinctly visible. This corneal lens consists of two plano-convex lenses of different densities and refracting powers. The plane surfaces of these being adherent, it follows that the prismatic corneal lens is a compound double convex lens (fig. 16, a). How remarkable that we should find this same construction in the most perfect microscopical lenses of to-day. The light after it has passed through the lens crosses the vacant space (fig. 16, c) and enters the conical lens (fig. 16, b). This space is surrounded with a dark pigment, which is narrowed to form a round hole, like a diaphragm in a microscope). The colored matter is continued downward and surrounds the conical lens. This consists of a simple double convex lens. At the apex it comes in contact with the bulbous expansion of the optic nerve (fig. 16, e), which extends in a line continuous with the axis of the ocelli until it meets the nerve of the other eyelets. These three unite to form a common trunk which communicates with the insect's brain. Besides these compound eyes

there are three simple eyes which consist of one single lens (fig. 15) surrounded by little bulbous subdivisions of the optic nerve called papillæ.

The Antennæ.—These. are composed of thirteen joints, the second from the head being much longer than the rest. With the exception of this joint all the segments of the antennæ are studded with perforations (fig. 8). Bleach one of these with chlorine and examine with a low power. It will be found to be covered with little sacs (fig. 11). Through the center of the antennæ the central nerve may be found, and with a high power little fibres may be seen branching from this and connecting with each of the little sacs, showing that they are organs of sense. Of which sense is not accurately known. Deprive a bee of both antennæ and its actions may be compared to those of an insane person.

The mouth.—The oral apparatus of the bee consists of two mandibles, two maxillæ, two labal palpi, and a ligula or tongue. The mandibles form the split pointed termination of the head. They may be seen separated at fig. 14, c, and are of a hard, dark, horny substance. They are formed and used much like a pair of toothed pincers. The maxallæ (fig. 14, d) consist of two long pointed blades, much resembling a pair of shears, but along the middle of each blade there runs a longitudinal rib covered with hairs. The blade is thin, transparent, and of a bright straw color, while the back is much thicker and stronger and supported by a series of transverse ribs. These instruments are used for cutting and molding the wax and in this operation they are aided by the ligula. This exquisitely formed instrument is composed of forty or more joints, which can be easily seen with a one-inch objective. These render the tongue perfectly flexible. At the end it is provided with a knob which is cartilaginous, the base is hollow and capable of inflation to a considerable size. In this hollow the nectar is collected

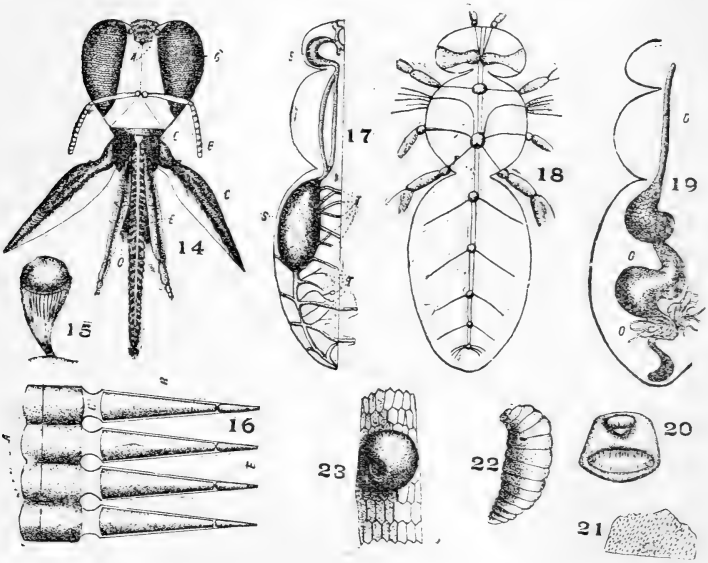
previous to its passing into the honey stomach. Extending the whole length of the tongue is a tube probably used for the passage of the nectar from the tip of the tongue to the mouth. While the tongue is stretched forth to collect the sweets from the flowers it is supported by the labial palpi (fig. 14, e), which are jointed and the lower segments covered with fine hairs.

To prepare the parts of the head for examination, soak for a fortnight in liquid polassæ to soften the skin and dissolve the fatty substance. Then wash in water, press between two pieces of glass until dry; drop a little turpentine upon them and let them soak in it a few days when they will mount well in Canada balsam.

The Legs.—In all bees the legs consist of five limbs, but in the worker-bee the fourth and fifth limbs of the hinder leg are very different from those of other bees. Examine these (fig. 12, a, b) with a low power. The tibia (fig. 12, a) becomes large as it approaches the tarsus (fig. 12, b), the first joint of which is very largely developed and covered with rings of stiff hairs set in regular rows. Where these two divisions of the leg come together a cavity is formed. This is the pollen basket. The inside of this cavity is smooth and around the upper edge is a row of lancet shaped hairs (fig. 13). These are straight on the side by which the pollen is received and curved on the opposite side in such a way as to prevent the pollen from falling out and at the same time to make the most room in the cavity. The right leg conveys the pollen to the left basket and vice versa. The foot of the bee is provided with forked claws (fig. 9) and with a central hollow cup-shaped organ studded all over with hairs. This is to aid her in walking on walls and smooth surfaces and is also used in performing her domestic operations.

The Wings.—These are four in number, the anterior pair being the larger (fig. 5). They are of a tough

membranous texture covered with fine hairs, and are furnished with nervures, with a set of vessels for the circulation of the blood, and another set for the circulation of air. That these wings may offer the broadest possible resistance to the air, the posterior pair are provided with a row of exquisitely formed hooks (fig. 10, m), while the anterior pair are provided with a rib or bar (fig. n) over which these hooks may be clapsed, thus forming an un-



broken surface. Bees use their wings to ventilate the hive much as we use fans.

The Sting.—What is usually known as the sting of the bee is really the sheath which contains the piercing apparatus (fig. 6, m). This consists of two long darts (fig. 6, n) barbed as shown in fig. 7, each barb having eight teeth; they are so placed when in use that the smooth edges come together, making a formidable weapon. At the base of the sting is a sac of poison which is operated by the same muscles as the sting. As the sheath con-

taining the weapons enters the flesh, a drop of poison passes down the hollow of the sheath into the wound causing instant death to the victim. In the queen the sting is curved and is also used as an ovipositor.

The Digestive System. From the mouth the food passes through the gullet (fig. 19, d) into the honey stomach (fig. 19, f). The part intended for honey is regurgetated and deposited in the honey cells, while that used for nourishment passes into the second stomach (fig. 19, g), where it is masticated by the gastric teeth (fig. 21). It then passes into the intestine. About the middle of the intestine are the biliary tubes, which correspond to the liver in animals, and these pour out their contents upon the food in its passage through the intestines.

The Respiratory System.—The bee breathes through spiracles which are little holes pierced in the external surface and connecting with the internal respiratory organs by little tubes or trachæ. The spiracles consist of two elongated apertures, one behind the other (fig. 20). The outer one is provided with a number of short hairs to keep out foreign substances. There are two pairs of these in the thorax and one pair in each segment of the abdomen. Through these the air is admitted to the air sacs (fig. 17, s) which communicate with one another by large trachæ (fig. 17, t). The abdomen being the heaviest it is provided with two large sacs, one on either side, from these extend trachæ to the other parts of the abdomen. The thorax being provided with wings has no air sacs but a large trachæ, which divides into two as it traverses the thorax. It connects the large air sacs of the abdomen with the smaller ones in the head, which are relatively large on account of the weight of the compound eyes. Thus the equilibrium is maintained throughout the whole body. The queen, whose abdomen is larger and heavier than that of the worker, but who

leaves the hive only once or twice during a lifetime, has no air sacs, the only air vessels being the large and small trachæ.

The Nervous System.—This consists of a pair of straight parallel chords of nerve substance that lie side by side and run along the whole ventral side of the body. Upon these chords are distributed several ganglia, resembling beads strung upon two strings (fig. 18). First there is the brain ganglion which is two fused into one and situated in the head above the throat. It sends out nerves to the compound eyes, the simple eyes and the feelers. The next centre sends nerves to the mouth and the first pair of legs. The central thoracic ganglion is the largest and supplies the nerves to the other four legs and to the wings. Behind this and in the abdomen are four of small proportions which give nerves to the different segments, whilst the last supplies the reproductive organs.

It has been stated that the air sacs are wanting in the queen bee, in their place two objects much resembling two bunches of grapes will be found. These are the ovaries and are composed of an assemblage of tubes collected in a bundle, closed at one end, the ether end opening into a common trunk called the "proper oviduct." These two ducts unite and form the "common oviduct" through which the eggs pass into the cells prepared for them by the worker bees. There are three kinds of these cells and the queen knows which eggs to deposit in the different cells. The queen cells are much larger than the others and are circular in form (fig. 23). The queen larvæ (fig. 22) are fed on different food from the others, but in case all the queen larvæ are destroyed a worker egg or a young larvæ may be transferred to a queen cell, fed on royal food and produce a queen bee.

The Dissecting Microscope.

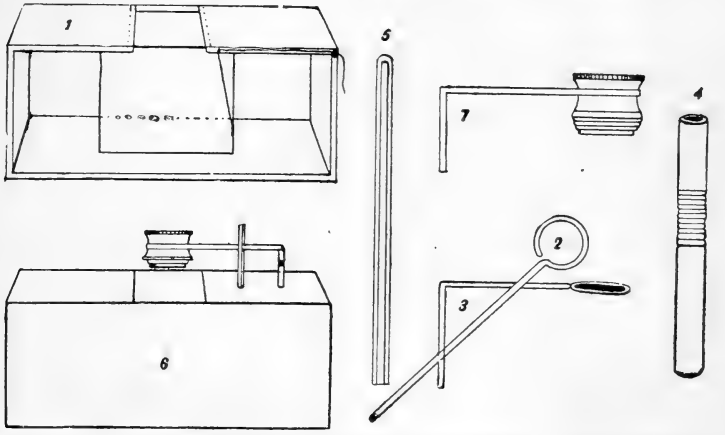
By PROF. F. M. GOODMAN, Ph.G.

To every student of botany a dissecting microscope is indispensable. There are several forms to be found in shops and this leads to frequent inquiry concerning the "best." When one is considering which is the best he is led to the consideration of the lenses, the construction of the hand rest, the method of supporting the lens and the means of altering its focus. The lenses usually employed in simple microscopes are either plano-convex or double-convex and lenses of these forms are subject to two inherent disorders; they distort the image and decompose light. The first is called spherical aberration, being occasioned by the sphericity of the lens. The second is chromatic aberration because the image seen by its aid shows a border of color not present in the object.

Spherical aberration may be overcome by making the lens much rounder on one side than on the other. This has the effect of rendering the rays of light from an object parallel and overcomes aberration of form. Using three lenses of the ordinary form tends to correct it, but the usual, because it is the cheapest, way is to place a diaphragm between the lenses, shutting out the peripheral rays and using only the central ones which are normally parallel. Chromatic aberration is overcome by cementing lenses of the proper form, of two kinds of glass together.

One combination of lenses which may be purchased of optical instrument makers is called the achromatic triplet. This is composed of three lenses of two kinds of glass, crown and flint, so adjusted in form and quantity as to overcome both aberrations. This gives exquisite definition and is justly regarded an excellent lens for a dissecting microscope, but it is quite expensive and the magnifying power is not increased over an ordinary

tripod, which costs but a trifle and as these are made containing two lenses, both double convex, one thicker and one thinner, they do excellent service. The lenses in the tripod are one and a quarter inches in diameter but are diaphragmed down to four or five eighths. The focal distance of the triplet and tripod may be the same and for the purpose of dissecting a one-inch focus is very useful as this is far enough from the working stage to allow of the free use of needles. One may estimate the focal distance of a lens or combination by holding it between a light and a sheet of white paper or between a window and a sheet of paper and noticing how far distant it is



from the paper when the image is clearest. It is well to do this when purchasing these lenses, as many of them focus at an inch and a quarter or more. Ten, divided by the focal distance, gives the magnifying power in diameters, ten is the distance in inches at which one usually holds an object for close inspection, the magnifying power of a lens of one inch focus is then ten diameters.

Having obtained the lens the next step is to mount it conveniently for use and this is one of the steps which every student should take for himself. The one used by the writer and which is here described, answers every

purpose and is more satisfactory on account of being home made and in costing but a trifle, than those for sale in the shops. The body is a tobacco box of the size holding six pounds of plug; it is about 4 by 5 and 13 inches long, made of sycamore with neatly dove-tailed corners. All particles of paper are carefully removed, the surface sandpapered and varnished, the inside is blackened with a mixture of lampblack and turpentine with sufficient varnish to prevent its rubbing off. This gives a dull black which is absorptive and non-reflective. Lay the box on its side with the bottom toward you and remove a section about three inches wide from the middle of what is now the top, cut away along the sides of this hole enough to let a piece of window glass in, flush with the surface of the box. The stage is now complete. Taking another piece of glass, or mirror if you prefer, a little larger than the stage glass, paste a strip of heavy paper, one inch wide, along one of the wider sides allowing it to project half an inch, the projecting part is then pasted to the back of the box, inside, at the upper angle, thus forming a hinge so that this piece of glass may be raised or lowered. This is accomplished by a string attached to the right hand edge by means of a piece of court plaster, passed through a small wire staple driven into the edge of the box near the stage and passed to the extreme right hand end.

When in use the open side of the box is turned toward the light and the glass reflector raised to the proper angle and retained by fastening the string. The stage and reflector are shown in figure one.

Next, unscrew the legs from the tripod and remove the band which carried them, make a neat loop with stout brass wire sufficiently large to encircle the body of the lens (fig. 2) and replace the lower band to hold the wire in place. Then, holding the lens perfectly horizontal,

bend the wire downward, at right angles, sharply, about four inches from the loop (fig. 3). This angle should be squared with a file. Now place the lens (fig. 7) over the center of the stage and at a point where the end of the wire touches the top of the box—toward the right—mark the place for the adjusting post. This is made of two pieces of brass tubing or gas pipe so cut with fine threads that one may be screwed into the other half or three-fourths of an inch (fig. 4), the outer piece of the two is now tightly fastened into a hole made at the point touched by the end of the wire, the inner is screwed into place and the wire is dropped into the hole through both, resting at its angle upon the upper edge. As the upper piece is turned, the wire carrying the lens is raised or lowered and is capable of very nice adjustment.

One thing more remains to be done. It will be noticed when the upper part of the adjusting post is turned the lens arm swings back and forth. This is overcome by taking another piece of the brass wire and making a long staple (fig. 5) to serve as a guide for the arm, the inner measurement of the staple is the same as the diameter of the arm wire, so that no motion is lost. This is secured in place by boring holes in the top of the box, the proper distant apart and forcing the legs of the staple into them. One finds plenty of room to work on this stage and ample rest for the hands. For dissecting use the ordinary handled needles and make one more by forcing the eye end of a good large needle into a pen stick, on a grindstone flatten two opposite sides for about half an inch from the point and continue grinding till a nice cutting edge is made, get this well sharpened and you have a most useful dissecting needle-knife.—*Graduate.*

Light.—The flame of the lamp used with the microscope may be intensified and improved by placing in the oil a small piece of gum camphor. The flame is thus rendered whiter and very brilliant. It is a good thing to do when resolving difficult diatoms.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892 Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Microbe of Scurvy.—Testi and Beri have succeeded in isolating from a piece of scorbutic gum a micro-organism, which they believe to be the cause of scurvy. The microbe stains in all the aniline dyes resists Gram's stain, is perfectly round, and generally united with one or more of its kind. Its culture renders gelatine fluid, and gives rise to a sawdust-like deposit. Inoculation of these cultures into guinea-pigs and rabbits gives rise to fever, and the necropsy showed hæmorrhagic stains in various parts of the body, and nodules of connective tissue new formation. Experiments were made in four cases, and in three out of the four the above mentioned results were obtained; in the fourth case the authors attribute their negative results to the fact that the patient had improved considerably under treatment. The diplococci found by the authors differ considerably from any that are usually present in the oral cavity of man.

Bacteriology in Australia.—The late Sir William Macleary bequeathed to the Sydney University money with which to found a chair of bacteriology, but the limitations being unsatisfactory to the latter the money was declined. Accordingly it has been given to the Linnæan Society of New South Wales which will maintain a bacteriologist and make investigations.

QUESTIONS ANSWERED.

NOTE.—*Dr. S. G. Shanks, of Albany, N. Y., kindly consents to receive all sorts of questions relating to microscopy, whether asked by professionals or amateurs. Persons of all grades of experience, from the beginner upward, are welcome to the benefits of this department. The questions are numbered for future reference.*

232 *Where can I get slides of common rocks, or how can I make them?—A. P. S.*

Rock sections can be obtained from dealers in microscopical goods and material or may be ground as follows:

Select a thin fragment of rock, rub one side flat with No. 70 emery and water on an iron plate, smooth with flour emery. Wash, dry, and cement the flat surface to a piece of glass, with hard balsam, using a gentle heat. Grind the rock as before until thin enough to transmit light through the translucent elements. Much care is necessary as the section becomes thinner. Finally dissolve the balsam cement with benzol or chloroform, liberate the section, wash with care because many minerals are extremely brittle, mount in balsam. A section can be made in 20 to 30 minutes if you are not in a hurry.

233 *What is Hollis' Glue?*—Hollis' Glue is a solution of shellac in alcohol, *i. e.*, shellac varnish.

234 *Will a few drops of glycerine prevent the cracking of shellac cements?—If not, what will?*—Glycerine is not suitable. Add ten drops of castor oil or of Venice turpentine to each ounce of shellac varnish.

PRACTICAL SUGGESTIONS.

BY L. A. WILLSON,
CLEVELAND, OHIO.

How To Obtain Free Trichina.—Place a portion of the flesh containing encysted trichina in dilute hydrochloric Acid. This acid dissolves the lime of the capsule and leaves the animals free. Then they may be picked out with needles under a dissecting scope or hand magnifier. Before placing the flesh in the acid it should be well teased. After removal, the trichina should be bleached in chlorinated soda. They may also be stained. A section of a cat's tongue with stained trichina makes an attractive slide.

Tripethelium.—This is a lichen but the method of manipulating it is applicable to a very numerous class found on bark. This specimen is found frequently on beech bark. The bark affected will have a number of raised black spots. Under a low power these spots will be found to be little elevated warts with often a little hole (astiole) in the center. On the outer bark nothing worthy of a high power can be found. Shave off the upper surface of a small piece and cut down into the inner bark. Then where the warts were little spots will be seen. Dig out one of these spots; transfer to a drop of potassium hydrate on a glass slip; mash and spread out with a spatula; then cover and examine with a quarter objective. The contents are hyaline and glassy white. Numerous apothecia each containing eight spores will be seen. The spores are long, glassy and acicular and eight locular and each division of the spore is marked with a double convex lens shaped marking. The method here described is applicable to many bark lichens all the Verrucaria and also to many of the Pyrenomycetes. Many of the fungi which affect bark are superficial and need but to be scraped off to be seen.

Blood Showing the Effect of Tobacco.—The effect of the excessive use of tobacco can be clearly demonstrated by the examination of a properly spread slide of the patients blood. In such cases red corpuscles will be found to be crenated, that is the corpuscle instead of possessing the absolute regularity of margin noticed in health will present a series of scallops some what irregular in their distribution. A few such crenated corpuscles, in the proportion of one to three hundred and fifty occur in normal health but in tobacco blood the ratio is sometimes as high one degenerated corpuscle to ten healthy ones, and often attains a much larger proportion. Opium and other narcotics produce the same result. Nervous excitement, certain diseases will frequently produce crenation and the blood in dense urine will often be found in this state. Where the patient is otherwise healthy a number of crenated corpuscles in his blood, as above indicated, may safely be ascribed to the excessive use of tobacco, opium or some narcotic and it is then high, time to stop their use.

SCIENCE-GOSSIP.

Hæmalum and Hæmacalcium Staining Solution.—Dr. Paul Mayer recommends the use of two staining solutions made from hæmatein, the essential staining constituent of logwood. When pure, hæmatein is a brown red powder, and crystallizes with one or three equivalents of water. It is most frequently found in commerce as hæmateinum crystallizatum, a compound of hæmatein and about 9 per cent. of ammonia, and is more properly designated ammonia-hæmatein. When pure, hæmatein and its ammonia compounds should not only be perfectly soluble in distilled water and alcohol, but should remain so on addition of acetic acid. From hæmatim is prepared a solution called for short, hæmalum.

One gram of the pigment is dissolved by aid of heat in 50 ccm. of 90 per cent alcohol and then added to a solution of 50 grm. of alum in 1 litre of distilled water. When cold it may be necessary to filter, but if the constituents have been pure this is quite superfluous. The solution is ready for use at once. It may be necessary to add a thymol crystal, in order to prevent the formation of fungi.

For staining sections hæmatin is used like Boshmer's hæmatoxylus, and if required the preparations may afterwards be washed with ordinary water, distilled water or 1 per cent alum solution.

Hæmacalcium, which is proposed as a substitute for Kleinenberg's hæmatoxylin, is made with the following ingredients: Hæmatein, or ammonia hæmatein, 1 gram; aluminium chloride, 1 gram; calcium chloride, 50 grams; acetic acid, 10 ccms; 70 per cent alcohol, 600 ccms.

The first two substances are rubbed together very intimately; the acetic acid and alcohol are then to be added, with or without the aid of heat. Last of all, the calcium chloride is added. The fluid is of a red violet hue. After having been washed in neutral 70 per cent alcohol, the preparations are violet or blue, and rarely require to be treated with acidulated alcohol. If too red they may be treated with 2 per cent aluminium chloride dissolved in acohol.—*Journal Royal Mic. Soc., Mittheil. Zool. Stat. zu Neapel.*

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THE MICROSCOPE.

DECEMBER, 1895.

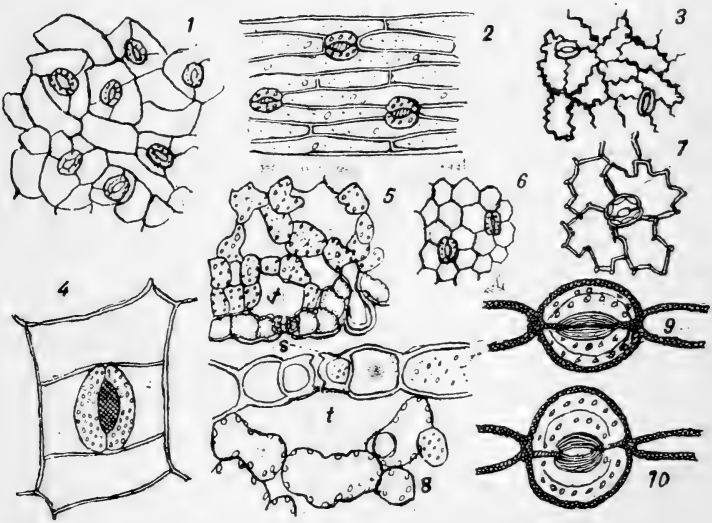
NUMBER 36. NEW SERIES.

Objects Seen Under the Microscope.

BY CHRYSANTHEMUM.

XXIX.—STOMATA.

The leaves of all plants are covered with a skin or epidermis which is composed of cells varying in shape in different plants, and in addition to these the under side of the leaf is provided with openings called stomata or breathing pores.



From the under side of the leaf of the Wallflower (fig. 1) take a thin section and examine it in water. Many irregularly shaped cells will be seen and among these some of a half-moon shape, having an opening between them; these are the stomata. Fig. 2 is from the under surface of a leaf of the Iris, fig. 3 from the Lemna minor, fig. 4 from

Tradescantia virginica, fig. 6 from Water Crawfoot and fig. 7 from Hellebore. One may notice the difference in the shape of the epidermis cells in the different plants, also the different arrangement of the stomata; some are in rows running lengthwise of the plant (fig. 2) and some are scattered without order. In some cases they point invariably in one direction (fig. 6), while in others they may point in any direction (fig. 1). There is a great difference in the number of the stomata. The under side of the oat leaf has 2700 to a square centimetre, while on the under side of the olive leaf there are 63,500 to the square centimetre.

Each stomata consists of a pair of cells much smaller than those of the epidermis generally and of quite a different form. These two are called the guard cells. Each guard cell is sausage-shaped and curved, the ends of the cells being firmly joined together, while in the middle they are separated a little, leaving an opening between them which communicates with the intercellular spaces.

Now make a section across the stomata lengthwise. This may be done by holding a piece of the leaf between two pieces of elder pith, or if the leaf is very delicate use the pith of the sunflower. Make an incision in the pith by laying it on something flat and hard and cutting lengthwise of the pith. In this way it is less liable to be broken. Then insert the leaf so it will come just above the top of the pith; hold it firmly together with the fingers, or perhaps better, fasten with a rubber band and cut a slice across both pith and leaf to make a smooth surface. Now holding the pith so that the razor will cut along the flat surface and not the edge, cut several very thin sections and examine in water. You will probably find some sections showing the stomata cut through the center. This shows the two guard cells with the pore between (figs. 5 and 8, s). The transverse of the guard-cell is roughly square, the walls are very thick, especially

at the two corners towards the pore, which is provided with projecting ridges.

Each stomata opens into a large intercellular space called the air chamber (figs. 5 and 8, t). The air chambers communicate with the intercellular spaces of the leaf and through them with those of the whole plant. The stomata then are the pores by which the intercellular passages of the whole plant open into the external atmosphere.

The stomata have the power of opening and closing. As a rule they open under the influence of light and warmth and close when it is dark and cold, or they open when the guard cells are distended and close when they are relaxed. To prove this take a section of the amaryllis, which has a long stomata, from a living plant and place it in water under the microscope. The guard-cells will be seen to open more and more and the pore between them opens to its full extent (fig. 10). Now replace the water by a solution of salt—a strength of two per cent is sufficient. The curvature of the guard-cells now diminishes and as they straighten themselves the pore between them closes (fig. 9). The pure water is absorbed into the guard-cells by the denser cap-cells so their turgidity is increased, and the comparatively dense salt solution withdraws water from the guard-cells and thus they tend to collapse.

That the guard-cells become curved as they distend is due to the ridges by which each cell is strengthened on the side towards the pore. This side is more rigid than the other and so offers greater resistance to stretching when water is taken up. Hence the more inflated the guard-cells are, the more convex they become on the exterior and the more concave on the side next the pore, thus making the space between the two cells larger. But when the water is withdrawn the reverse happens.

To make a permanent mount first strip off the epidermis, and to prevent it from curling, spread it out quickly

on a slide and add a drop or two of alcohol. Let it remain until clear, then rinse in water, stain in ammonia carmine or iodine green. Then remove from the staining fluid, rinse in water, pass through weak, strong and absolute alcohol, then place in oil of cloves for a few moments and transfer to a slide. From the end of a wire drop sufficient xylol balsam to cover the specimen and allow it to settle of itself; then put on the cover, being careful not to entrap air bubbles.

The vegetable sections prepared by W. White may be used to advantage when fresh specimens are not available. These are already stained and mounted between gelatine films. They can be soaked in turpentine until clear and mounted in balsam as above.

On a New Method of Entrapping, Killing, Embedding and Orienting Infusoria and Other Very Small Objects for the Microtome.

By John A. Ryder.

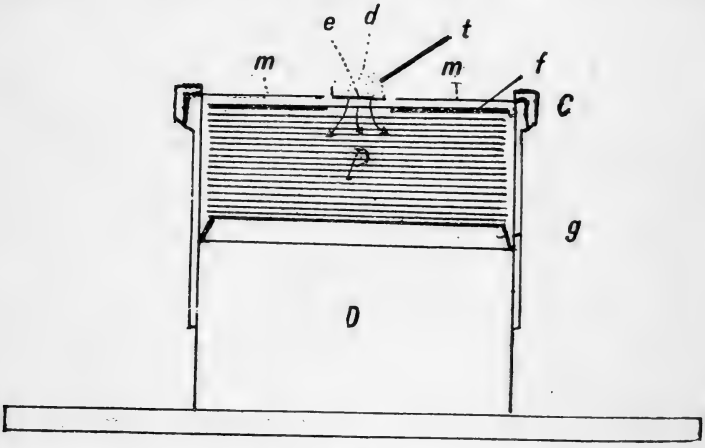
[Abstract of an article in the American Naturalist.]

A reliable method of capturing, killing, staining and dehydrating minute organisms has long been a desideratum with biologists, especially when such objects fall far below 1-100th of an inch in diameter. After trying a number of devices, I hit upon a plan that is not only very simple, but also capable of wide application, for by its means organisms as small as 1-2000th inch in diameter may be caught and held.

The filter upon which the objects are caught consists of thin slices of elder pith. Get good, clean, whole pieces of elder pith, and clamp a piece into the holder of a Schanze or other sledge microtome, so as to make transverse sections of it, taking four to six divisions of the microtome wheel to each section. The knife should be set at an acute angle with the line of movement of the knife car-

riage, as in cutting celloidin. With fresh pith somewhat thinner sections may be cut. Upon examination the slices will be found to be perforated at regular intervals by openings caused by cutting through the very thin cellulose walls of certain of the pith cells. A good supply of these little filters can be cut and kept ready for use at any time.

The next step is to cut some ordinary white filter paper into disks or squares one inch in diameter. With a damp tooth-pick moisten a point, about the size of one of the elder filters in the center of one of these disks. By means of a heated wire, saturate all except the central



moistened portion of this disk with paraffine. Prepare a discoidal pad, composed or ten or twenty superposed thicknesses of filter paper and upon these place the disk saturated with the paraffine. An ordinary, extra large live-box, provided with a mica cover, in the center of which a perforation 5-8 inch in diameter has been made, is a good device for holding the disks together. The accompanying figure shows the apparatus in vertical section.

The mode of operation is as follows: Place the pad of filter paper (P) upon the glass disk (G) of the live-box; lay the disk saturated with paraffine (f), upon P; put the

cap (C) with its centrally perforated mica cover (m m) in place and slip it down over the drum (D) so as to hold f down upon P. Then with a fine nozzled pipette moisten the central exposed part of f, and with a pair of fine forceps pick up one of the little disks of elder pith and lay it, convex side down, upon the center of f, when it will immediately flatten out and adhere to f, nearly covering the central area not covered with paraffine.

On placing a drop of water (d) swarming with animalcules on E, it will be found that the water will be rapidly drawn through e and f into P, in the direction indicated by the arrows. In this way several drops of water may have much of their animalcular population separated out and caught upon the surface of E. To kill the contents of D add a little saturated corrosive solution or osmic acid one per cent, by simply thrusting the charged end of a wooden rod (t) into the drop (d). The animalcules are at once precipitated upon the upper surface of E, where they are caught and held in the meshes of the pith cells. Remove the filter e by raising its free edge slightly with a needle, then grasp this edge with a pair of sharp pointed forceps and transfer to a watch glass containing 50 to 60 per cent alcohol. With gentle handling Ciliates may be passed through several reagents without becoming detached.

Even orientation may be very easily effected, either by sketching with a low power the outline of the whole disk and the position and direction of the axes of the very minute objects upon it, or by shaving down the block after the disk of pith is embedded so as to make it sufficiently transparent to show the shape of the adherent organisms through the semi-transparent block. The proper cutting planes may now be indicated on the margin with lithographic ink.

I have found it very easy to thus capture, hold, kill, dehydrate, stain, embed and cut Paramœcium aurelia.

Euplotes, Stylonychia and Halteria will also adhere to these disks. Halteria is about the size of a white blood-corpuscle, and the fact that it may be entrapped and treated as here described shows what a wide range of utility is promised by this method. It will doubtless be found useful in the study of minute eggs and larvæ.

I find that these disks may be mounted entire. One in this way may get most instructive preparations, often having a half dozen genera on a single slide. Staining is also entirely under control; any of the usual stains may be employed and their action watched under the microscope. With this method it has been found possible to cut 18 longitudinal and 50 transverse serial sections of Paramœcium with a thickness of 2.5 to 5 mm. with the Ryder Microtome set to one or two teeth of the wheel.

The fixation of the sections on the slide may be effected by means of Gustav Mann's albumen method. Take the white of an egg (30 c. c.), shake up with 300 c. c. of water for 5 minutes, filter twice. Paint clean slides on one side with this mixture by the aid of a glass rod and stand them on end to dry. The albumenized side of the dry slides may be distinguished by breathing upon them. The sections are stretched by floating the ribbon of paraffine containing them on warm water (30 c). Immerse one end of the albumenized slide in water and float and arrange the sections on it, albumemized side uppermost. Place the slide on a water bath to dry, when the paraffin may be removed with xylol or turpentine, after which the staining may be done on the slide. This method of fixing sections with albumen is much simpler and more practical than with Meyer's formula.

The novelty and simplicity of this new method, as well as its wide range of applicability will in many cases be found to materially facilitate work, especially the work of those engaged in the study of Protozoa, or of very minute ova or larvæ. A very simple form of this ap-

paratus, for holding the filtering paper in position, is being made and offered for sale by Chas. Lentz & Sons. —*American Naturalist.*

Appearance of Spontaneous Generation.

By Dr. BOUYON.

Translated from *Le Micrographe Preparateur* by Rene Samson.

When we bring into a narrow tube a very small pinch of Algæ, gathered with the end of a pole in a pond, in order to examine it under the microscope, we find a small number of species of animals; then, every day, we see new ones which before did not appear to be found there. Thus we can, after a few weeks' research, find, in a few cubic centimetres of water and a centigramme of filamentous Algæ almost one half of the ordinary Infusoria. No doubt that after a longer time we could still discover many others. This phenomenon is so striking, when we have made the experiment, that we are tempted to believe (as I have heard it taught in Paris) that all Infusoria arise one from the other, under ordinary exterior influences. It is necessary to know that Infusoria are as distinct one from the other as Entomostracæ or Mollusks; only, the same species can present natural or accidental forms which have been wrongly described, by the first microscopists, as so many different species.

We understand that, the first day, we cannot see them all: some species have passed unperceived; they are found again later. Besides, there are eggs, germs which were not yet hatched, and which produce new species the following week. And more, there often are transformations which require two or three weeks in which to take place, and a larva which we had taken for a perfect infusoria, can hatch and give birth at the end of twenty days to a new being, which seems fallen from heaven.

It is thus that if we observe a quantity of Oxytricha

crassa, which are superb Infusoria with long sticks, small horns and thick, slender and well visible cilia, we will find after some time some Trichoda lynceus, which are quite small and have a form which recalls this of the Cloportae. Never would we believe that such a beautiful Infusoria could be the larva of such an insignificant animal, which differs a little from the ordinary type of Infusoria.

If we think that all their transformations are not yet known, we will not be surprised at the continual renewal of what we have described as distinct species. When the water evaporates, the Infusoria die or are encysted. There again their forms change very much. If we add water again to the preparation, they continue to live under odd forms, which have caused them to be described as if they were durable. It is thus that we have mistaken certain cyclidium for Proteus tenax and so many other deliquescent Infusoria and Rhizopods for Amœba, of very distinct species. A little quantity of water is, indeed, sufficient to make an Infusoria or only a part of its protoplasm live under the amœboidal form. Certain Rhizopods, with soft body, not protected by a skeleton sustain thus complete modifications, which causes us to believe in the production of new Infusoria.

The Paramœcium aurelia can present, following a preliminary coupling, a series of olives disposed like a collar, which are simply spermatic capsules. It presents then a peculiar aspect which has probably been the cause of having it mistaken for another animal, with characteristic nucleus.

But they are still two beings of the same species, since they are two different forms of the same individual. At last, the wind which raises the germs of Infusoria, the rain which beats the roof and takes away its Systolides, the carpets shaken and which spread their dust, are three causes which add new Infusoria to the cultures ex-

posed in the open air, or window sill. It is then very natural to find in a preparation more different forms of Infusoria than there were to be found at first.

Caution to localities where typhoid fever is prevalent.—The germs of this disease are now known to be in the discharges from the bowels, and recently have been found in the urine; they are known to be in the spleen, and probably pervade the entire body, of a person having typhoid fever. The germs are not rapidly destroyed by drying. Typhoid fever is probably always spread directly from person to person.

All discharges from the body of a person having typhoid fever should be disinfected.

This is a time of extraordinary danger from typhoid fever, as has been predicted, since the low water in wells was apparent in June, July, August and September.

Prudence dictates that all drinking water, not known to be above suspicion, should be boiled, and cooled in some place where typhoid fever germs will not gain access to it.

Public notice of every infected place should be given, by placard on the premises and otherwise if necessary, so that no person may unguardedly drink water or take food from a source likely to be contaminated with the germs of typhoid fever.—Henry B. Baker.

A test demonstration of the new Electrical Projection Apparatus recently invented by Messrs. J. B. Colt & Co., of New York, including their new patent Automatic Feed Electric Lamp, Projection Microscope, Vertical attachment, Polariscope, etc., took place in Prof. Monroe's lecture room at the Columbian University, corner 15th and H streets, N. W., Washington, D. C., on November 4th, at 8 p. m. The apparatus is of the greatest scientific value and many most interesting experiments were tried. This exhibition was of very great value to those interested in the science of Projection. Henry H. Brown, 1010 F Street, N. W., is the Washington agent for Messrs. J. B. Colt & Co.

THE MICROSCOPE.

New Series, 1893.

For Naturalists, Physicians, and Druggists, and Designed to Popularize Microscopy.

Published monthly. Price $1.00 per annum. Subscriptions should end with the year. The old series, consisting of 12 volumes (1881–1892), ended with December, 1892. Sets of the old series cannot be furnished. All correspondence, exchanges, and books for notice should be addressed to the Microscopical Publishing Co., Washington, D. C., U. S. A.

CHARLES W. SMILEY, A. M., EDITOR.

EDITORIAL.

Pittsburg for 1896.—The Executive Committee of the American Microscopical Society has accepted the very kind invitation of the Iron City Microscopical Club, to meet in the City of Pittsburg, Pa., for the next annual meeting of the Society. We shall announce the exact date in next menth's issue.

Physicians' Visiting List for 1896.—We have just received from I. Blakiston, Son & Co., Philadelphia, the Physicians' Visiting List for 1896. This new edition presents several improvements. More space has been allowed for writting the names and to the "Memoranda Page;" a column has been added for the "Amount" of the weekly visits and a column for the "Ledger Page."

J. Tempere, 168, Rue Saint Antoine, Paris, has just issued a new Catalogue of microscopical preparations in all the branches of Natural History. That catalogue forms a book of seventy-five pages and contains a considerable number of objects. All the readers of the Microscopical Journals can apply for it, and will receive the Catalogue free.

Superstitions About the Microscope.—At a recent meeting of the St. Louis Microscopical Society one of the younger members, who is teaching histology, but who is still unsophisticated as to what is sometimes expected of microscopists,

related the following incident as a sample of *naivete'* of some medical practitioners when it comes to the judicious and unprejudiced appreciation of the merits and achievements of the microscope.

A physician had sent him a vial of purulent fluid, which had been gathered during the operation of a tumor of the breast, with the request of examining the liquid microscopically in order to determine whether the tumor was a carcinoma.

Similar requests are, in our experience, by no means infrequent. Some surgeons, and not only obscure ones, will remove with a curette a few cells of the mucous membrane of the uterus and expect of a microscopist to make an examination of the removed tissue and report whether the affection of the organ is of a malignant or a benign nature.

We have compared similar requests to the question of a student (?) of anatomy, who asked the demonstrator, after removing a piece of a nerve-trunk, "Professor, what nerve is this?"

Such occurrences, of which most histologists can cite parallel cases, form one of the arguments for the necessity of a microscopic training of all physicians, at least in a sufficient degree that the possibilities and impossibilities of an histological diagnosis are properly understood and appreciated.

While the very energetic use of a sharp curette may occasionally remove pieces of tissue large enough to exhibit the characteristic structure of a neoplasm so that a positive diagnosis can be made, the cases in which the tissue removed with a curette consists of a *pell mell* of tissue elements, without any indication of its architecture, are so predominating that the diagnosis based upon its examination is practically worthless. Such examinations, although they may in rare cases furnish presumptive evidence which, in connection with the clinical manifestations of disease, may lead the surgeon to arrive at a conclusion as to the necessary therapeutic procedure, are apt to bring microscopy into discredit. The removal by the curette of an abundance of epithelial cells or young connective tissue cells may lead a microscopist to suspect a carcinoma or a sarcoma, but a surgeon has no right to perform a radical operation upon such a mere suspicion, when it is an easy matter for him to remove a wedge-shaped piece of tissue large enough to make an exact histological diagnosis.

The neglect of insisting upon similar requisites for the purpose of arriving at a decision based upon an histological examination, as well as hasty examinations and the hasty expression of opinions are often detrimental to the proper estimation and appreciation of microscopy. Surgeons will sometimes ridicule the diagnosis of sarcoma by a microscopist, because the neoplasm rapidly improves under mercury and iodides; if they have themselves a passable knowledge of practical histology they will readily see how such a mistake may sometimes happen. These errors are not so apt to occur if the histologist has a properly prepared specimen and sufficient leisure to make a thorough examination. But such examinations require a familiarity with the subject. They take up much time, have great practical value and should be well remunerated.

The Suspension of "Insect Life."—This action was recently ordered by the Secretary of Agriculture and cuts off a valuable periodical. The reasons for the suspension were practically these:

1. The very commendable activity of other bureaus than that of entomology during the past few years had led their members to feel that they also could edit valuable periodicals, and they made known their desires to the Secretary. If Entomology had its monthly, why not all the other bureaus? The Secretary found it impossible to grant all the new requests for permission to print. He could not consistently grant to Entomology what he refused to others.

2. The general adoption of the periodical plan of publication by Government departments was likely to prove offensive to private publishers and became a killing sort of competition. How could private publishers compete against free Government issues? The Secretary very wisely decided not to enter the periodical publishing business as a destroyer of private enterprise.

The suspension occurring at about the time of Prof. Riley's death has led some to infer a connection between the events. Nothing could be further from the truth. Not only did Prof. Riley leave the Department a year ago but while he was in it, his connection with *Insect Life* was little more than nominal, the active management having always been in the hands of Prof. L. O. Howard, then assistant and now the Entomologist.

PRACTICAL SUGGESTIONS.

By L. A. WILLSON,
CLEVELAND, OHIO.

Yeast Cells.—The examination of yeast affords a fine study in cell formation.

For the purpose use a very small piece of compressed yeast,—a piece no larger than half a pin's head ; or scrape a very small portion from a cake of yeast. Place the portion scraped off on a plain glass slip, in a drop of water, cover and examine with a quarter inch objective. When the cake of yeast is used the yeast will be obscured by the large starch grains composing it. Remove most of the cells with the forceps before covering.

The yeast plant is Saccharomyces cerevisisae. Notice the mother cells and the daughter cells. These cells average .008 mm. or .0003 of an inch in diameter and reproduce the daughter cells by budding.

Another form is produced by division of the protoplasm within the parent cell. By gently heating the slide after it is covered, the process of budding may be accelerated and beautifully displayed upon the slide.

It may be better seen by keeping the covered slide in a warm moist chamber for some hours. The daughter cells may be developed by growing yeast upon fresh cut slices of potato kohlrabi, carrot or upon small slabs of plaster of Paris. The preparations must be kept moist by covering with a bell jar and may be seen in a week or ten days from the beginning of the experiment.

Pus Cells.—It is interesting to examine pus by covering and examining with a quarter inch objective ; then remove the slide, lift the cover and place a drop of acetic acid upon the specimen, and examine. Upon the second examination each cell will exhibit from one to four nuclei.

Carbolic Acid for Mounting.—This is a valuable medium for mounting. Ordinary alcohol used in mounting insects makes them stiff and hard ; but carbolic acid penetrates the specimen and readily mixes with other fluids used in mounting, such as water, glycerine and Canada balsam.

It does not harden tissues nor make them stiff. For this reason insects can be preserved indefinitely in carbolic acid in a fit condition to be mounted at any time. The more delicate parts are rendered quite transparent by long soaking in the solution, but this is no detriment to them.

Carbolic acid is not an acid but belongs the chemical series of alcohols.

Insects are killed instantly by immersion in the acid and when thus killed their parts will generally be found to be spread out.

The carbolic acid used should be the strongest solution.

Obtain the crystals and dissolve them in just water enough to keep it fluid at ordinary temperatures. To use it for mounting it is only necessary to drop the specimen into the acid and in a few moments transfer it to the medium in which it is to be mounted.

India Rubber for Glycerine Mounts.—The following is said to act satisfactorily for glycerine mounts. Heat India-rubber till it becomes sticky ; dissolve it in benzol, ring both cover and slide, then let it remain till tacky ; arrange the object in glycerine, press down the cover, wash away spare glycerine and use asphalt varnish or other finish.

SCIENCE-GOSSIP.

Library Catalogues as a Possible Means of Infection.—The Independent says: "It is remarkable that in this day of germs and germicides nobody has invented a sanitary library card catalogue. Every one that recalls the unspeakable filth of the old and now departed card catalogue of the Astor Library must suspect that it was a highly-effective agency in the spreading of disease. The bound catalogue is perhaps even worse, for an attentive observer must often have noted that the average reader in a public library turns the leaves of the catalogue with the aid of a finger dampened by application to his own lips. The commercial exchange of germs by this method must reach a vast volume of transactions in the course of a year."

Photo-Micrography.—The art of photographing the image of a microscopic object, which image has been enlarged by the microscope, is called photo-micrography, in contradistinction to the art of producing microscopic photographs of large objects, which require the aid of a microscope to render the details visible. Dr. J. W. Draper, of New York, is supposed to have been the first to take photo-micrographs by the daguerreotype process, as he was the first to take portraits by this method, since which time thousands have probably practiced this art, abroad and at home. In this country Draper, Rood, Fowler, Deames, Rutherford, Seiler, Mercer and Col. Woodward, Drs. Curtis and Sternberg, of the army, stand prominent as masters of photo-micrography. The object of photo-micrography is to produce a faithful photograph of the enlarged image of a microscopic object, which shall not only show everything apart from color, that we can see in the microscope, but even more, as it is the most reliable and easy way of making faithful records of the appearances and measurements of microscopic objects. Be it for illustrations of scientific books or for lantern slides for lectures, or for supplying evidence in law courts in cases of adulteration, forgery, murder, etc., its importance is obvious. In the domain of botany, biology, physiology, pathology, bacteriology, chemistry, petrology, etc., and in fact, wherever the microscope is used, there photo-micrography is destined to become daily of more service and importance. The method of taking a photo-micrograph consists chiefly in the following operations. Focussing and illuminating the object in much the same way as for visual examination at the eye-piece end of the microscope, with the camera; focussing on the ground glass; replacing the latter by the holder containing the sensitive plate and making the exposure and finally developing the negative. To command success in photo-micrography requires not only the possession of a good microscopical apparatus and camera, but also an intimate acquaintance with the principles of microscopical illumination for photography, which depends for correctness first of all upon the choice of the illuminator, and secondly, upon the condenser and that of the objective, the rule being that the aperture of the condenser ought to be the same as that of the objective if we wish to obtain critical images.

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FOR SALE.—Crouch Intermediate binocular, circular glass stage, mechanical centering on substage, four eye pieces, achromatic condenser polarizing attachment, stops for dark ground and oblique illumination, parabaloid, two solid eye pieces made by Spencer. All in perfect order and have been used very little. $100. GEO. A. BATES, Auburndale, Mass.

FOR SALE.—Barbadoes Earth, containing many rare forms of Radiolaria. Send 40 cents, stamps, for inch cube of this material to
S. S. DAY, 23 Olyphant St., Morristown, N. J.

FOR EXCHANGE.—I will exchange my photograph (*carte de visite*) with all American Diatom-friends. Y. C. RINNBOCK, Wien XI-1, Simmeringg Hauptstr, 14 Austria.

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COMPILED BY HANS M. WILDER, PHILADELPHIA, PA.

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